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Unasylva

Volume III, Number 2 • March-April 1949

COMMONWEALTH MYCOLOGICAL INSTITUTE
23 MAY 1949

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A Review of Forestry and Forest Products

March-April 1949 Vol. III, No. 2

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Unasylva is prepared by the Division of Forestry and Forest Products and published by the Information Division of FAO at the Organization's temporary headquarters in Washington, D. C. It is printed in Baltimore, Maryland, U.S.A. Unasylva is published in English, French, and Spanish. Unasylva may be obtained from the following sales agents: Australia: *H. A. Goddard Pty., Ltd., 255a George St., Sydney;* Canada: *The Ryerson Press, 299 Queen St. W., Toronto 2;* China: *The Commercial Press Ltd., 211 Honan Rd., Shanghai;* Czechoslovakia: *F. Topic, Narodni Trida 9, Prague 1;* Denmark: *Ejnar Munksgaard, Norregade 6, Copenhagen;* East Pakistan: *Farcos' Publications, 2 Inglis Rd., Dacca, P.B. 13, Ramna;* Egypt: *Librairie de la Renaissance d'Egypte, 9 Sh. Adly Pacha, Cairo;* Finland: *Akateeminen Kirjakauppa, 2 Keskaskatu, Helsinki;* Hungary: *Grill's Bookshop, R. Gergely A.G., Dorottya Utca 2, Budapest V;* India: *The Oxford Book & Stationery Co., Scindia House, New Delhi; The Oxford Book & Stationery Co., The Mall, Simla; The Oxford Book & Stationery Co., 17 Park St., Calcutta; Messrs. Higginbothams, Mound Rd., P.B. 311, Madras;* Italy: *The European Regional Office of FAO, Villa Borghese, Rome;* Netherlands: *N. V. Martinus Nijhoff, Lange Voorhout 9, The Hague;* Norway: *Johan Grundt Tanum Forlag, Kr. Augustsgt. 7A, Oslo;* Union of South Africa: *Central News Agency Ltd., P.O.B. 1033, Johannesburg;* United Kingdom: *H. M. Stationery Office, P.O.B. 569, London, S.E.1;* United States of America: *International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N. Y.; United Nations Bookstore, Lake Success, N. Y.; FAO Documents Sales Service, 1201 Connecticut Ave., Washington 6, D. C.* Requests from countries where sales agents have not yet been appointed may be sent to: FAO Documents Sales Service, Food and Agriculture Organization of the United Nations, Washington 6, D. C., U.S.A. Annual subscription, $3.50; single copy, 65 cents.

A farm in Nebraska with shelterbelts around the farm buildings and the cultivated fields.

The Volga Valley Authority

The New Fifteen-Year Conservation Plan of the U. S. S. R.

By RAPHAEL ZON

THE fifteen-year conservation plan recently announced by the Union of Soviet Socialist Republics makes no claim to new or revolutionary methods. Crop rotation, strip cropping, water impounding, planting of forest strips, reforestation and fixation of shifting sands are well-known methods, successfully tried in many lands. What makes the plan sensational is the scale on which it is being attempted, the limited time (15 years) for bringing it to completion, and the bold purpose of changing the climatic and water conditions of a vast region.

The most significant feature of the plan is the integrated approach to the problem, the realization that all factors which contribute to the highest productive use of land are interrelated and that in order to effect a lasting land improvement the problem cannot be taken up piecemeal but must be attacked as a whole, simultaneously on all possible fronts, with every means at the command of science.

No region can sustain for long a stable productive agriculture if its forests are allowed to deteriorate and become waste land. Neglect the forests and a Pandora's box of disastrous effects is opened. Snow and rainfall permeate the ground under the protection of dense forest cover and enrich the subsoil with moisture; without forest protection they run off as flood waters damaging agricultural land, impeding navigation, causing property damage, and endangering human life. Poor sandy soils when overgrazed or improperly cultivated become blowing sands encroaching upon good agricultural land. As a result of excessive erosion by wind and water, deep gullies scar the land; the ground waters sink lower. Deprived of the moderating influence of the forest, the land is exposed to the extreme fluctuations of the weather. Droughts occur more frequently. The whole environment becomes less hospitable to human life. There are, unfortunately, only too many such degraded regions throughout the world bearing tragic testimony to the folly of man.

Plans and Projects

A clear and concrete purpose has motivated the U.S.S.R. in undertaking this gigantic project. The Ukraine and Central Russia, with their black soils (chernozem), and the fertile fields of the Volga region and the Northern Caucasus comprise the richest agricultural lands. They are Russia's bread basket; yet, because of their proximity to the Kizel Kum and Kara Kum deserts and the prevailing dry easterly and southeasterly winds that blow from the direction of those deserts, the whole region is exposed to periodic droughts. In 1946 the region suffered from a severe drought, and as recently as 1948 serious crop failures resulted from drought in many parts of the Volga River Basin.

Through its present plan the U.S.S.R. is seeking to insure itself against the uncertainties of weather and to build up in the region a dependable, highly productive, and diversified rural economy. The territory covered by the plan embraces the prairie (steppes) and semiprairie (prairie intermingled with groves of natural forest) region, mostly land lying along the middle and lower stretches of the Volga River in the southeastern part of European U.S.S.R. Asiatic Russia is not included in the plan. While the conservation measures are to be concentrated in the east and southeast, they are chiefly intended to provide a protective barrier as a defense for the agricultural land lying farther west.

The plan calls for five principal activities each supplementing the other and all aiming at the same goal: to reduce the threat of drought and increase agricultural production.

Creation of protection forest zones or barriers

These zones, distinct from shelterbelts around cultivated fields and orchards, are to be established on divides, ridges, slopes of ravines, river banks, and lake shores, and around ponds and reservoirs. The greatest project of this nature is to be the planting by the Ministry of Forestry of the Federated Republic of eight long, continuous protection zones oriented at right angles to the prevailing dry southeasterly and easterly winds. Each of these eight protection forest zones is to consist of 1 to 6 parallel narrow belts of trees, each belt from 30 to 60 meters wide, with a distance of about 300 meters between the belts. The total length of all eight protection zones will be over 5,300 kilometers, divided as follows:

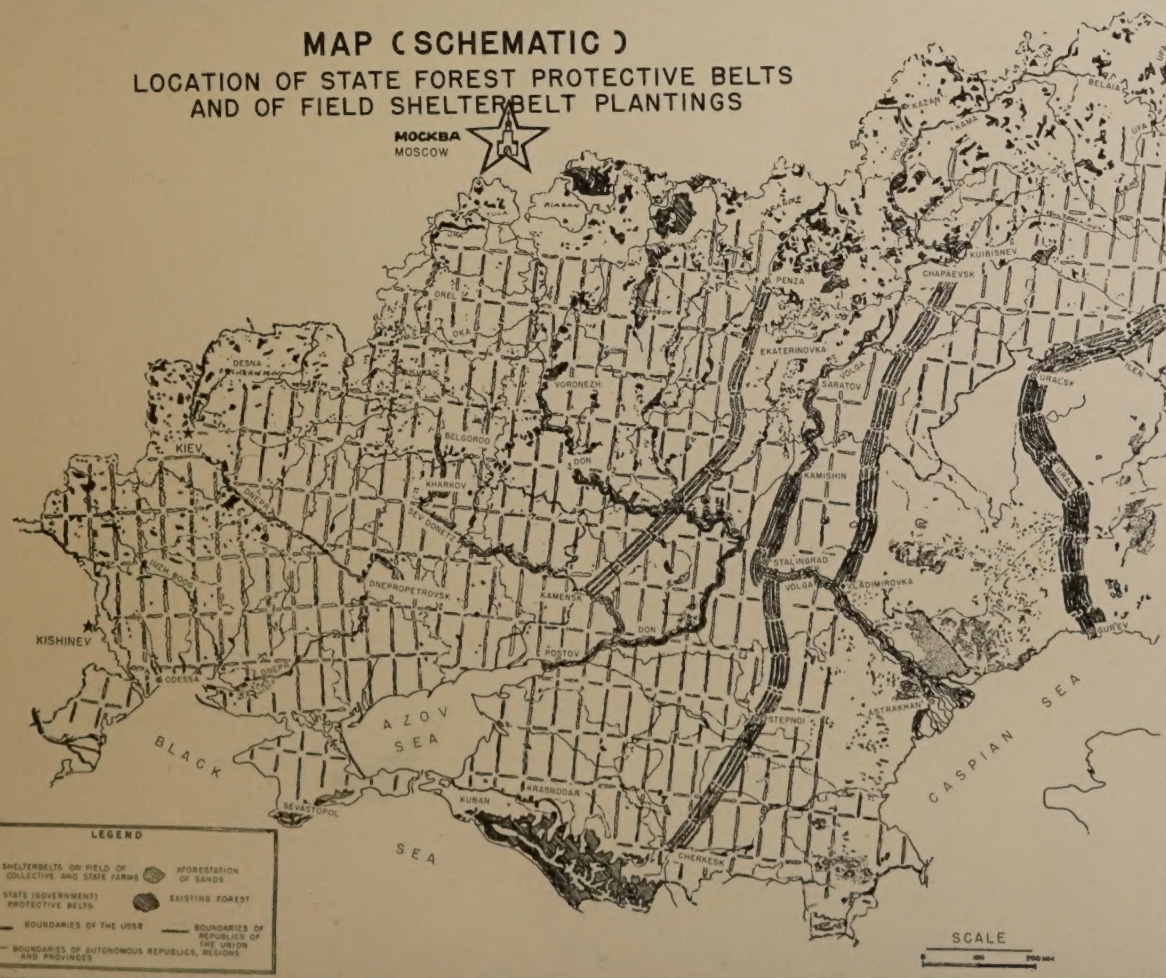
One forest zone, 100 meters wide and 900 kilometers long, will extend from Saratov to Astrakhan along

К А Р Т А (С Х Е М А)

РАЗМЕЩЕНИЯ ГОСУДАРСТВЕННЫХ ЛЕСНЫХ ЗАЩИТНЫХ ПОЛОС И ПОЛЕЗАЩИТНЫХ ЛЕСОНАСАЖДЕНИЙ

MAP (SCHEMATIC)

LOCATION OF STATE FOREST PROTECTIVE BELTS AND OF FIELD SHELTERBELT PLANTINGS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CHAPAEVSK
PENZA
ORENBURG
ORSK
ORSKAYA
ORSKAYA-VOLGA
ORSKAYA-URAL
ORSKAYA-TOBOL
ORSKAYA-IRTYSH
ORSKAYA-OMSK
ORSKAYA-ALTAI
ORSKAYA-KOKCHETAV
ORSKAYA-PAVLODAR
ORSKAYA-SEMIPALATINSK
ORSKAYA-ALMA-ATA
ORSKAYA-TALDY-KURGAN
ORSKAYA-CHIMKENT
ORSKAYA-TASHKENT
ORSKAYA-FRUNZE
ORSKAYA-DZHAMBUL
ORSKAYA-ALMA-ATA
ORSKAYA-KZYL-ORDA

both banks of the Volga River. Another belt will extend in the direction of Penza to Kamensk on the northern Donetz River. This zone, which is to consist of 3 parallel tree belts, each belt 60 meters wide with 300 meters between the belts, will be 600 kilometers long. A third zone, stretching 170 kilometers in length from Kamishin to Stalingrad along the divide between the Volga River and one of its small tributaries, the Ibovly, is to consist of 3 parallel belts of trees, each belt 60 meters wide, with 300 meters between the belts. A fourth zone 580 kilometers long, will run from Chapayevsk, near Kuibishev, to Vladimirovka-on-the-Volga. It is to be made up of 4 parallel narrow belts each 60 meters wide with 300 meters between the belts. A fifth zone from Stalingrad to Cherkessk (Northern Caucasus) of 570 kilometers length will be in the form of 4 narrow belts each 60 meters wide with the usual distance of 300 meters between the belts. The sixth zone, the widest and the longest, is to run from the southern spurs of the Urals to the Caspian Sea along the banks of the Ural River for 1,080 kilometers. It is to contain 6 parallel belts (3 on the right and 3 on the left bank of the river). Each belt is to be 60 meters wide, but the distance between the belts only 100 to 200 meters. A seventh protection zone is to be extended along the banks of the Don River for 920 kilometers between Voronezh and Rostov-on-Don, and will consist of only one 60-meter-wide belt. The eighth forest zone will be located along the banks of the northern Donetz River for a distance of 500 kilometers from Belgorod to the Don River and will consist of only one belt 30 meters wide. The widest forest zone will be only a little over 2 kilometers wide.

The purpose of these forest zones is to break the force of the hot dry winds from the deserts, to prevent wind and water erosion of the fertile soils of the Volga area and Northern Caucasus and of the black soils of Central Russia, to improve moisture conditions, and generally to temper the climate of the region. The vast undertaking is to be completed by 1965.

The corollary of the measures for the planting of forest protection zones is the decree prescribing special methods in the management of the more or less extensive natural forests which occur in the prairie and semiprairie sections of the region. Such stands are found in a number of specially favored areas. They are not to be taken out of utilization, but cutting is to be restricted; no clear cutting is allowed; fellings and thinnings must be made in accordance with the best forest practice in order to improve the remaining stands and increase their density and growth.

Establishment of forest strips or shelterbelts around croplands and orchards on collective and state farms

This is an extension on a greatly increased scale of a policy that has been in effect for some time. Russian agronomists and soil scientists, on the basis of long-term studies and experience, lay great emphasis on the efficacy of strip planting in protecting crops against desiccating winds, in increasing yields, in conserving moisture in the soil, and in reducing loss of soil by wind and water under the climatic conditions of the treeless and semi-treeless regions. Such planting in the next 15 years is to spread over an area of 5,709,000 hectares of collective and state farms. The total area occupied by the shelterbelts themselves will be only about 5 or at most 10 percent of the area to be served. The collective farms are to be responsible for planting forest strips on the largest portion of the area, namely, 3,600,000 hectares, and for the entire cost of the work. The Ministry of Forestry is responsible for planting on an area of 1,500,000 hectares, and the Ministry of State Farms for planting on the remaining 600,000 hectares.

An interesting and novel feature is the payment of a bonus to the members of the collective farms proportionate to the success of the plantation. If not less than 80 percent of the trees or shrubs planted survive the first year, 10 labor-days per hectare will be added to the regular pay received for such work. If survival after the first year is more than 85 percent, 15 labor-days will be added for each hectare thus planted. If 2- and 3-year-old plantations show not less than 80 percent survival of the trees and shrubs, both the original stock and the later plantings in blanks, 8 labor-days will be added. This is to encourage the growing of sturdy nursery stock as well as careful planting and subsequent care.

Specific instructions are given concerning the species of trees and shrubs to be planted on the 19 different types of soil and under the different climatic conditions. The width of the strips should be determined by the lay of the land and by the purpose the plantation is to serve. For instance, to protect level land chiefly against dry winds, the strips may be only from 10 to 20 meters wide; to protect the fields against erosion by the washing away of the top soil the planting should be done along contour lines in strips from 20 to 60 meters wide; and so on for every set of conditions. The list of trees and shrubs suitable for planting in the treeless and semi-treeless region is varied and long, but emphasis is laid on the desirability of using oak, wherever it is at all possible, as the principal species. To produce an early and lasting effect, the forest strips should contain a balanced combination of fast-growing and slow-growing species. It is laid down as a general rule that the forest strips should contain from 10 to 15 percent fruit-bearing trees and shrubs. While the creation of new shelterbelts over the vast territory is getting under way, the collective and state farms are directed to restore to full effectiveness within the next two years (1949-50), by their own means and labor, all previously existing shelterbelts which were cut down, burned, or otherwise badly damaged during the war.

Fixation and afforestation of shifting sands

To protect the fertile fields of the Volga region, Northern Caucasus, Ukraine, and Central Russia from encroachment by sand drifting in from the dry prairie and semidesert lying close by to the east and southeast, the plan demands that all lands from which the moving sand originates be stabilized as quickly as possible through afforestation and revegetation. Some 322,000 hectares are to be planted within the next six years (1949-55) with drought-resisting forest trees and shrubs adapted to sandy soils, namely, 22,400 hectares in 1949, 43,110 in 1950, and 256,500 in 1951-55. To expedite the process of stabilization, a large area is to be sown immediately with hybrid sorghum and certain grasses so as to convert the sandy areas into grazing and hay land. Provision is made for obtaining enough sorghum seed in 1949 to sow an area

of 300 hectares, in 1950 for an area of 20,000 hectares, and in 1951 for 100,000 hectares.

The planting of the contemplated protection forest zones, the creation of forest strips around fields and orchards, and the afforestation of the easily blown sandy soils present a vast reforestation project. An enterprise of such magnitude will require the collection and storage of thousands of tons of tree and shrub seeds, the establishment of many forest nurseries, an enormous supply of tools and mechanical equipment, and great numbers of technical personnel. The plan calls, for instance, for the growing of close to 34,000 million seedlings within the next six years. Some 3,000 million are to become available during 1949, 4,000 million in 1950, and the rest between 1951 and 1955. To supply this number of seedlings, some additional 230 government forest nurseries are to be established in 1949-50; special forest nurseries are also planned for the collective farms to meet their own needs for planting material, one forest nursery for each 5 to 10 collective farms; and all other phases of the work are projected on a similar large scale.

Adoption of a system of crop rotation suited to prairie and semiprairie conditions

While the planting of protection zones and forest strips is destined to create more favorable conditions for agriculture and insure its stability, the general adoption of the most improved agricultural practices, especially of a proper crop rotation, is considered essential for obtaining higher yields, for developing animal industry, livestock breeding, and other branches of diversified farming, thus increasing the whole output of farm products. The plan therefore dwells in great detail on the need for the introduction on all state and collective farms in the treeless and semi-treeless regions of crop rotations with summer fallow and two or more years of perennial legumes and grasses or five to seven years of perennial legumes and grasses followed by about two years of grain and other crops.

Although the directive calls for initiating crop rotation on state farms by 1949 and on collective farms by 1950, the adoption of the crop rotation system by all state and collective farms in the prairie region must be gradual. Leguminous and other fodder seeds are lacking and until a large supply of such seed becomes available, progress will be slow. It is expected, however, that by 1955 the transition will be completed on all state farms and also on the 77,509 collective farms. The crop rotation system when fully applied to the farms of the prairie and semiprairie sections of the European part of the U.S.S.R. will embrace an area of some 120 million hectares.

Hand in hand with the introduction of the crop rotation system, definite soil conservation measures are prescribed, such as plowing, planting and cultivating on contours (across the slope), the use of contour buffer strips of perennial grasses known as strip cropping, and so forth. Stress is also being laid on use of high-grade selected seed for planting, application of proper organic and mineral fertilizers, and measures for eliminating disease, insect pests, weeds, gophers, and field mice. Since the present bottleneck is the shortage of seed, efforts are to be made to increase the supply, especially of leguminous and grass seeds. Large stocks of perennial grass seeds are being accumulated, and more than 116 special farms have been organized for the cultivation of selected seed of perennial grasses.

Water Conservation

In order to utilize to the fullest extent all local waste water, the plan calls for the creation of numerous ponds and reservoirs on collective and state farms: in natural depressions, at river sources, in ditches and ravines. The impounded water is to be used for irrigation, fisheries, and hydroelectric power for the needs of agriculture. In all, some 44,230 ponds and reservoirs are to be created on collective and state farms. The surveying, designing, and technical direction are to be provided by the government, but the actual construction is to be done by the farmers themselves and out of their own resources.

Implementation

A Central Administration for Protective Forest Planting is to be established under the Council of Ministers to co-ordinate, direct, and control the activities of the three ministries (Forestry, Agriculture, and State Farms) responsible for the actual carrying out of the plan in its entirety. It will also co-ordinate the collection of scientific data and results and interpret the findings. It will be charged with building up the large staff of trained technicians necessary for the work. Finally, it is to publish a monthly technical journal devoted to the discussion of questions of agricultural improvement.

Priority is given to the manufacture of special agricultural machinery and other equipment and implements to facilitate and expedite the realization of the plan. Some 570 stations are to be created in the next two years to perform the mechanical tasks connected with engineering, planting, cultivating, and other phases of the work.

To carry out such a gigantic plan successfully requires a stupendous number of trained technicians. Training is therefore being undertaken on a large scale: in colleges, schools of agriculture and forestry, and universities at the professional level; and also at the farm level. Some 100,000 leaders trained in forest planting, and in grass and crop rotation are being given special two- and three-week courses this winter. Many colleges have increased the enrollment of students specializing in farm-forest management and more than 4,000 specialists are expected to graduate in 1949.

Wider Implications

The plan will be watched with considerable interest in North America because the prairie and plains of Canada and the United States present similar conditions and therefore similar problems, although possibly in less aggravated form. The solution also lies along similar lines.

If a map of the United States or of the U.S.S.R. is turned at right angles, the same succession of climate and vegetation is evident. In the United States this succession proceeds from east to west, in the U.S.S.R. from north to south.

On the Atlantic coast of the United States some swampy areas lie close to the shore. Then appear the forests, first a belt of spruces and pines, and then in

Fields of sugar beets in California protected from unfavorable winds by shelterbelts.

the Appalachian and Allegheny Mountains region to the west a dense forest of oaks, maples, birches, and similar hardwoods. Farther westward, the hardwood forest gradually thins out, grassland openings appear in it, and the forest gives way to the great treeless prairie and plains region. At first the prairies are covered with tall grass but farther westward as the climate becomes drier the tall grass is replaced by short grass and the prairies by plains. These extend westward to the foothills of the Rockies, Cascades, and Sierras. The slopes and heights of the mountains are covered with dense forests of pines, spruces, and firs. The forest becomes particularly luxuriant on the western slopes of the mountains facing the Pacific Ocean.

In the Arctic region of the U.S.S.R. there is a zone of perpetual frozen swamp, known as tundra. South of it is a wide belt of pines, spruces, and firs—the taiga. This is followed by another forest belt, a forest of oaks, maples, and beech. Farther south the hardwoods gradually peter out and are succeeded by flat grass country—the steppe. Becoming more arid to the south, the steppes extend to the foothills of the Caucasian Mountains. The slopes and heights of these mountains are covered with a dense forest of fir, similar to the Douglas fir, spruces, and pines of the Rockies, Cascades, and Sierras. Beyond the mountains lie the waters of the Azov and Black Seas.

The Russian steppe, like the American prairie, is the bread basket of the country. Yet both the steppes and the prairies are largely flat regions with deficient rainfall ranging from 350 mm. to 525 mm. (14 to 21 in.) a year. They suffer from frequent droughts and are constantly exposed to strong winds. In Russia the prevailing and most damaging winds come from the east, while in the United States they are largely southerly and southwesterly winds. Both regions possess very fertile black soil, known as chernozem, in Russia. It is natural that the people in both regions should seek means to counteract the unfavorable climatic conditions and to improve living conditions. One method used was the planting of trees, protective forest strips, windbreaks, or shelterbelts around farmsteads and cultivated fields.

Russian steppes were settled much earlier than the American prairies. Although tree planting in the steppes dates back to the early nineteenth century (1830), not much progress was made until the end of the century. In 1891 the Russian Government, after a severe drought and famine, appointed a Commission of soil experts headed by Professor V.

V. Dokuchayev, originator of the genetic classification of soils now universally accepted, to study the causes of the periodic crop failures in the steppes and to recommend measures for improving conditions. Among other things, the Commission recommended planting protective forest strips or shelterbelts which it believed would (1) protect the farms against the winds; (2) aid in ripening grain; (3) decrease evaporation; (4) effect a more uniform distribution and retention of snow; (5) raise the water table; (6) decrease the range of temperature fluctuations; (7) attract rains; (8) raise the productivity of waste and unused lands; and (9) control soil erosion and shifting sand.

As a result of these recommendations, the first forest experiment station in Russia was established, paradoxically enough, in the treeless region. The experimental plantations were large and numerous and some of them attained international renown. Among these are the Kammenaya Steppe, Derkul, and Mariupol plantations situated in south-central Russia north of the Sea of Azov. These plantations were maintained continuously until the Germans overran the territory. They provided information of great scientific and practical value in regard to the effect of shelterbelts on crops, species most suitable to plant, and methods of planting. The results were so encouraging that the Soviet Government, especially after the famine of 1921, urged the planting of shelterbelts, particularly in the central and lower Volga regions. Between 1928 and 1932 the area of planted shelterbelts rose from 2,000 to about 14,000 hectares (5,000 to 35,000 acres), and the Second Five-Year Plan provided for planting over an area of 350,000 hectares (865,000 acres) around cultivated fields and orchards.

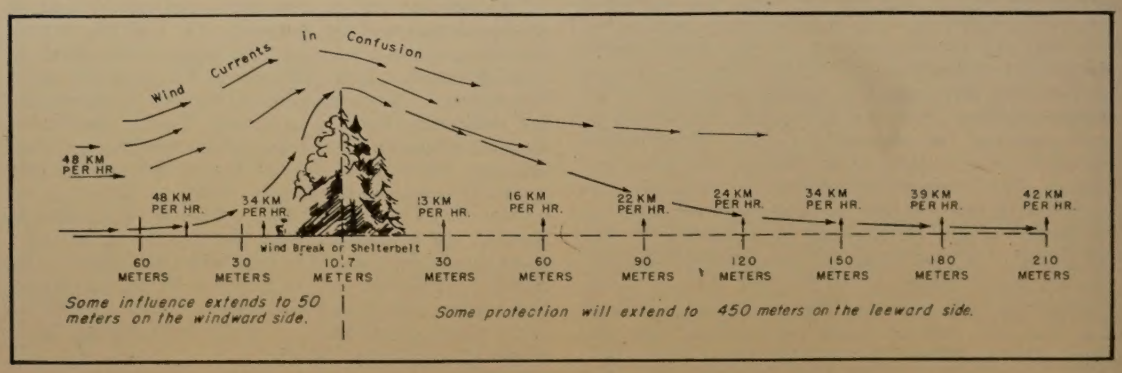
The United States of America has also had considerable experience in this field. Shelterbelt planting began with the settlement of the prairies. Early settlers planted groves of trees around their houses, and some of the plantations were remarkably successful.

In 1873 the U. S. Congress passed the Timber Culture Act. Under this Act any settler who planted 16 hectares (40 acres) of trees on his 65 hectares (160 acres) became the owner of the land. The vastness of the territory, the sparseness of the population, the lack of effective administrative control and of experience prevented in many cases the enforcement of these requirements. Still, as a result of the Timber Culture Act, the prairies are dotted today with shelterbelts around individual farmsteads. American settlers, unlike Russian settlers, did not settle by villages, but each farmer on his own land, separated from his nearest neighbors sometimes by several miles. The country was still under virgin sod and only a small part was brought under the plow. The need for planting protective strips around fields was less urgent than planting for the protection of the houses and barns.

Conditions in the United States, however, have changed radically within recent years. High prices during the First World War stimulated the cultivation of thousands of acres of grassland although large areas were distinctly unfit for farming. The increased area of plowed land forced thousands of herds of cattle and sheep onto other and poorer areas. This led to overgrazing and consequent destruction of the protective grass cover. The stage was thus set for a large-scale national calamity.

As a result of severe droughts that prevailed in the United States in the early 30's, large areas, deprived of their protective vegetative cover and exposed to the drying action of the sun and wind, became a vast breeding ground for destructive dust storms which blanketed almost the entire eastern half of the United States and ruined thousands of farms. As a result, there arose an insistent public demand for measures to remedy the situation. Planting protective forest strips around fields and orchards in the prairie-plains regions was one of the measures proposed.

It was not until 1934 that shelterbelt planting in the United States assumed national importance as a part of the huge program of relief and rehabilitation inaugurated in that year for the relief of the inhabitants of the drought-stricken prairies and plains. In



Tree plantings are used by farmers and landowners to protect their homes and livestock from cold and hot winds and to assist in the control of erosion on cultivated fields caused by high winds. In the United States, farm homes protected on the north by a good windbreak such as is illustrated in this drawing will save 25 percent of the fuel requirements for the winter. When a windbreak protects both on the north and the west, a saving of 34 percent can be expected. Fields protected by shelterbelts made up of 5 to 10 rows of trees help to control wind erosion, contribute substantially to the saving of moisture, and protect crops from damage by high winds. Cattle and horses that are protected by windbreaks require less feed and gain in weight more rapidly. A survey made in the State of Iowa discloses that stock feeders are convinced that a windbreak enables them to save from $5.00 to $10.00 on the cost of feeding every steer.

Well-established eucalpytus windbreak in Southern California used to protect citrus crops from the high winds in this area.

June 1934 the Government made public a proposal to plant shelterbelts on about 512,800 hectares (1,282,000 acres) of farmland within a 160 kilometer (100 mile) wide zone extending through the prairie-plains region from the Canadian border to southern Texas approximately along the 100th meridian. The area to be planted in ten years under this plan compares fairly closely with the 350,000 hectares (865,000 acres) in the 5-year period in the Russian program. Since the planting was undertaken as a relief measure, the entire cost of establishing shelterbelts was at first borne by the Government; later, however, the farmers on whose land the planting was done were to contribute half of the cost in the form of labor, maintenance, and care. With the start of World War II, the shelterbelt project was temporarily discontinued and still remains in a quiescent state. From 1935 to 1942 96,400 hectares (238,200 acres) of field shelterbelts, or 29,900 kilometers (18,600 linear miles) of belts were planted on some 33,185 farms.

The Russian scientists, after more than 50 years of experimentation and observation on forest strips planted around fields, have come to very strong and definite conclusions as to the efficiency of such plantings in minimizing the ravages of wind and drought, increasing the yield of crops, preventing erosion, and increasing the moisture in the soil. They found, for instance, that on fields surrounded on four sides by forest belts from 16 to 20 meters (52 to 65 feet) wide, or 10 percent of the enclosed area, the wind velocity decreased 35 to 40 percent and the loss of water by the plants, 30 percent. The snow was 1½ to 2 times as heavy within the forest belts as on the open steppe; and surface drainage, when the forest belts were in best condition, was reduced to nothing. These improved conditions are reflected in increased yields. For instance, in the open steppe on fields which are not protected by forest strips but which previously were under legumes and grasses, the yield of spring wheat (with fertilizer) was about 21.2 quintals per hectare (31.5 bushels per acre); a spring wheat field treated in exactly the same manner, but within forest belts yielded about 30.5 quintals per hectare (45.4 bushels per acre). Oats in the open steppe, previously under grass, yielded about 18.6 quintals per hectare (51.9 bushels per acre); similar fields within a forest belt yielded 21.7 quintals per hectare (60.5 bushels per acre). Winter wheat under similar conditions in the open steppe, yielded 18.2 quintals per hectare (27.1 bushels per acre), within a forest belt, 23.4 quintals per hectare (34.8 bushels per acre

These findings are confirmed in general terms by

numerous observations on shelterbelts planted in the Uniter States of America. When the Russians speak of the value of shelterbelt planting, they are on solid scientific ground and are backed up by long experience. A most concrete and striking demonstration of the effect of shelterbelts was furnished during the severe drought of 1946—admittedly the worst drought in 50 years. Although the yield of grain at the Kammenaya Steppe Experiment Station where the fields are well protected by forest strips was only about half of the normal yield, it was still 3 to 4 times greater that year than on the adjoining unprotected fields. One state farm which has some 600 hectares of well-developed shelterbelts produces on an average each year more than 25 quintals of winter wheat per hectare.

Planting of forest strips around fields is only a part, though an important part, of the Russian plan. There is also the work under way on the Volga River and its tributaries which is aimed at improving navigation, developing electric power, maintaining the water level of the Caspian Sea, and bringing millions of acres of now dry land into cultivation by irrigation. In a sense, these projects constitute a "Volga River Authority" similar to, but more comprehensive than, the Tennessee Valley Authority or the proposed Columbia River or Missouri River Authorities in the United States.

No specific estimates of the cost of the enterprise are given in the blue print of the plan. The project for the most part is still largely in the planning stage, and there is usually a wide gap between the plan, no matter how thoroughly it is thought out, and its realization. So many of the factors entering into the plan are essential to its harmonious and successful execution that a failure in any one of them may endanger a large segment of the plan itself. A cycle of dry or wet years, for instance, might retard or expedite the plan. A failure of tree-seed crops, an epidemic disease in forest planting stock—things that foresters know only too well do happen—might upset the plan considerably, at least as to the time of its completion.

But no matter whether the Russian conservation plan will be or will not be completed in 15 years, whether it will succeed fully or only in part, whether it will bring all the benefits that are expected from it or not, it is an inspiring thought that man need not always be a destroyer and plunderer of the riches of the earth, but that he can also be a builder and master of his own environment.

Photographs accompanying this article and chart on page 60 were furnished by courtesy of the Soil Conservation Service, U. S. Department of Agriculture.

Forest Problems of Africa

By the Staff of the Division of Forestry and Forest Products

WITH the exception of North Africa, which is almost entirely within the Mediterranean vegetation zone, and the southern part of the Union of South Africa, Africa is a land of tropical forests.[1]

These forests are influenced either by a warm, humid climate with a short dry season or by a hot tropical climate with a long dry season. The types of tree association—it is difficult to term them all "forests"—are extremely varied, not only botanically, but also from the economic standpoint. The feature they have in common is that they are inhabited by primitive peoples whose mode of life is generally harmful to the forest.

The figures in "The Forest Resources of the World,"[2] recently published by FAO, show that in Africa out of a total area of 2,245 million hectares, 290.2 million hectares are covered by productive forest, and 526.7 million hectares by other forests. Other records show that only 309.3 million hectares are used for agricultural purposes. The productive forest area is unevenly distributed. The per caput area varies from 11.27 hectares in the Belgian Congo to 0.13 in Kenya and 0.02 in Somaliland. Of the 290.2 million hectares of productive forest, it is estimated that 137.6 million hectares are now accessible, comprising 767,000 hectares of coniferous forest, 136,173,000 hectares of broadleaved forest, and 627,000 hectares of mixed woods.

Two broad categories of forests emerge:

1. Closed formations which include the dense, evergreen equatorial forests and certain high-altitude forests.

2. Open formations which can be subdivided into two major classes: (a) shrub and thorny savannah formations of the Sahel type, and (b) the so-called "Sudanese formations" of Central Africa which include the seasonal forests (Guinean) and the tree savannahs (of the Sudan type).

There is a clear and constant relationship between the occurrence of each of these types of vegetation and the prevailing climatic factors. In Africa, there are two such factors of special significance, the annual

[1]For articles on African forests which have appeared in *Unasylva* see "The Disappearance of the Tropical Forests of Africa," by A. M. A. Aubréville, Vol. I, No. 1, and "An Estimate of the Shrinkage of Africa's Tropical Forests," by H. L. Shantz, Vol. II, No. 2.

[2]*Unasylva*, Vol. II, No. 4, p. 161.

Handsquared timber skidded by tractor and winch in the Cameroons. (Photo by courtesy of Agence economique des colonies)

amount of rainfall and the length of the dry season. Each zone has its own peculiar forest flora and, with a few exceptions, principally on the borders of the forest zones, there is very little merging of types.

Closed Formations: Rain Forests and High-Altitude Forests

This category includes what is usually and incorrectly called the "virgin" forest. Its area in Africa is much more limited than is generally believed, for such forests are found only on the west coast and in the central part of the continent. In French Guinea, the rain forest comprises a few isolated tracts with special characteristics in the Fouta Djallon mountains. It spreads out in Liberia and the Ivory Coast, the southern part of the latter being entirely covered by such forests with the exception of some few coastal savannahs, and in the Gold Coast it becomes an imposing mass reaching eastward to the plains of the Volta River. This main forest belt is then interrupted but appears again down in Nigeria where it merges into the immense equatorial forest which covers the larger portion of the Cameroons, Gabon, and the Congo basin in the French and Belgian territories.

These forests need minimum annual rainfall of 1,350 millimeters and can withstand only a short dry season, three months at the utmost. The forests are of very mixed composition and extremely complex in character. The Meliaceae is considered as economically the most important family. These are the trees that first made a name for the African forests. The mahoganies in particular, which are relatively plentiful in these stands, include many species of *Khaya* and *Entandrophragma*, such as: *Khaya ivorensis* (African Mahogany), *Khaya anthotheca* (Krala, Acajou blanc, or mahogany prefixed by the region of origin, e.g. Uganda), *Entandrophragma cylindricum* (Sapele, Sapelli or Aboudikro), *Entandrophragma angolense* and *E. utile*, etc. Among the species of this family mention may also be made of *Guarea cedrata* (Bossé, Diambi, or scented Guarea), *Turreanthus africana* (Avodiré or Lusamba) and *Lovoa klaineana* (Dibétou, Bombulu, or African Walnut).

The Leguminosae, less important commercially, is the most widely represented family, both by variety of species and proportion of growing stock. Several species may be mentioned: *Distemonanthus benthamianus* (Movingui), *Brachystegia* sp. (Bubinga), *Erythrophleum ivorense* (Tali) and *Piptadenia africana* (Dabema, Dahoma, or Bokungu). Among the Rubiaceae, the two most important commercial species are *Mytragina stipulosa* (Abura, Bahia, Vuku) and *Sarcocephalus diderrichii* (Opepe or Badi-Bilinga). The Gaboon okoumé, *Aucoumea klaineana*, of the Burseraceae family, is certainly the most important commercial African species on account of its relative abundance in pure stands and its reputation as a veneer wood. Finally, among the Sapotaceae, *Mimusops heckelii* or Makore; among the Sterculiaceae, *Triplochiton scleroxydon* (Obeche or Ayous-Samba) and *Tarrieta utilis* or Niangon; among the Moraceae, *Chlorophora excelsa* (Iroko or Kambala); among the Combretaceae, *Terminalia superba* (Limba, Fraké, or Afara) which is abundant in the Belgian Congo and highly valued commercially and *Terminalia altissima* or Framire. The ebonies of the genus *Diospyros* (Ebenaceae) must also be included.

There are two main climatic types and the classification generally used is that of the English botanists, who make a distinction between "rain forest," characterized by *Triplochiton scleroxydon* and "deciduous forest" characterized by such species as Azobé, *Lophira procera* (Ochnaceae), Niangon, and Avodiré. Beside these climatic types, another type is often found consisting of secondary forest with a predominance of light-demanding species, of rapid growth but little economic value. There are also a great number of edaphic types, such as mangrove forests consisting of *Rhizophora* species, coastal forests, swamp forests, etc.

The high altitude forests are not as homogeneous and their botanical composition is even more varied. They are found on the slopes of the Fouta Djallon Range in Guinea, in the western part of the Cameroons, and again in much larger blocks in Uganda, Kenya, Tanganyika, and Katanga, as well as in the mountain ranges of Ethiopia, and in the eastern part of the Union of South Africa, and a few rather degenerate stands exist in Madagascar.

In Kenya, for instance, above the dense forests at medium elevations, which are of no great economic value, the main species of the mountain forest proper is the evergreen *Podocarpus*, mixed to a greater or less degree with cedars (*Juniperus procera*) according to altitude. Still higher up come the bamboo forests, (*Arundinaria alpina*). In the Ruanda-Urundi, however, the bamboo is followed by another *Podocarpus* belt.

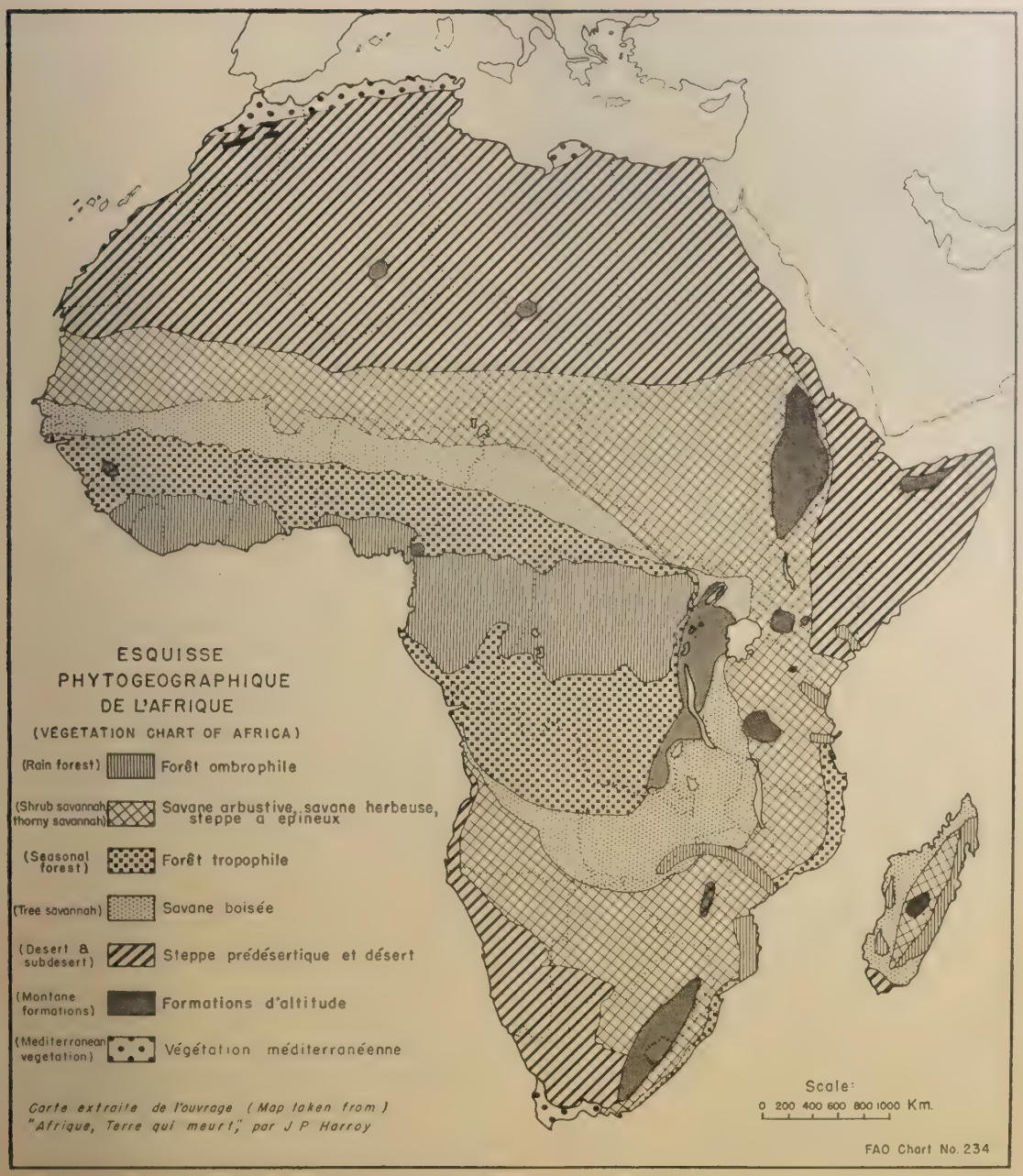
Open Tropical Formations

These include seasonal forests (of the Guinean type), tree savannahs (of the Sudanese type), and shrub and thorny formations (of the Sahel type). Bordering on the dense forest zone, the "Guinean" type zone covers fairly large areas of Africa. It is often termed "park land" forest which gives a good idea of its appearance. French foresters often called it *la zone des grandes espèces sociales*, because there are extensive pure stands of very characteristic species.

These forest types with several dominant species are found throughout Africa wherever similar climatic conditions exist. They form a vegetation belt, either subxerophilous or xerophilous, which stretches west to east from Guinea north of the Cameroons to Ubangi-Shari, then curves south and skirts the Congo Basin. In the north, the dominant species are Leguminosae of the genera *Berlinia*, *Uapaca*, and *Lophira*. These are replaced to the east by similar species of the genus *Isoberlinia* which, in the southern hemisphere, give place to *Brachystegia*. The Katanga, Tanganyika, and Nyasaland regions contain some fine forests of *Brachystegia*, mixed with *Berlinia* and *Uapaca*. Similar formations, such as the *Tapia* forests with *Uapaca* predominant, are found locally as far as Madagascar.

In the "Sudanese type" zone, the wooded savannahs are characterized botanically by species such as karite or shea tree, *Butyrospermum parkii*; baobab, *Adansonia digitata*; kapok, *Bombax buonopense*; and cailcedra or bastard mahogany, *Khaya senegalensis*.

These formations lie in regions with an annual rainfall varying from 500 to 1,000 millimeters and a rather long dry season lasting from seven to eight and a



half months. One of the most important characteristics of this zone is that it consists of formations which are already very open, and in which the soil is covered with a continuous sheet of herbaceous vegetation. These immense savannahs burn every year during the dry season. The "bush fires" are ground rather than crown fires. Although the savannah trees have become resistant to fire, in the long run the damage caused to the stands is considerable, and it is obvious, as Professor A. Chevalier has pointed out, that the savannah fires which have been recurring for centuries act as a true climatic factor upon the forest vegetation.

Shrub and thorny formations of the Sahel type which cover large areas of Senegal, Sudan, Nigeria, the Chad, the Anglo-Egyptian Sudan, eastern Africa, Rhodesia, and the southern part of Angola, are extremely open and scattered. Thorny species predomi-

Acacia tall grass savanah, with scattered trees, Zizyphus spina-christi, *in the Anglo-Egyptian Sudan.* (*Photo by courtesy, H. L. Shantz*)

nate, particularly the Acacias: *Acacia senegal, A. arabica, A. tortilis,* etc.

Since this vegetation exists with an annual rainfall of 200 to 500 millimeters through a long dry season extending over a period of from nine to ten and a half months, the trees are perfectly adapted to arid conditions. The ground cover is sparse and in some places even non-existent.

Evolution and Role of Forests

It is necessary to study the evolution and role of these various types of forest lands in order to determine the problems of each zone. It may then become possible to deduce the measures that should be taken to preserve and improve the forest, and even to establish new stands; to judge the conditions under which it would be possible to tap these enormous resources as a means of improving the living conditions of the African populations; and also to help overcome wood shortages of other continents.

Although all authorities agree that the great rain forests once occupied much larger areas than at present, their complete disappearance is unlikely as a result of present abuses. What is actually occurring is impoverishment of the stands rather than real destruction; if, for any reason, the forest is destroyed, the vegetation cover appears again as second growth. The present impoverishment is due to the increasing amount of clearing for cultivation by the African populations and to present-day methods of exploitation which lead to the progressive disappearance of seed bearers of desirable species.

The importance of equatorial forest areas is threefold. In the first place, it can be safely assumed that the dense forests increase the quantity of annual rainfall, and this becomes particularly evident during the dry season. They also retain water in the surface layers of the soil much longer.

Secondly, there is the sociological aspect. In former times the people were dependent on the forests for food, clothing, and housing, as well as for medicinal supplies. Although they now have other resources, they still obtain a large portion of their requirements from the forest, and, most important of all, the forest affords land for crop cultivation. With the agricultural practices now in use, the forest constitutes the only source of renewable humus in this part of the world.

Thirdly, the potential economic value of the timber and other products from the forest is enormous. The main species of precious and common woods, hardwoods, semihard woods and softwoods of proven market value have already been listed, and it is estimated that these alone might provide an average supply of from 10 to 25 m^3 per hectare. These figures are low compared to figures for managed homogeneous forests, and exploitation is always costly under such conditions. If the potential capacity of these forests is to be used more completely and if timber prices are to be lowered, it will be essential to increase the number of species commercially acceptable and to cut logging costs. This is the major problem of African forestry. At the same time, the depletion of the stands resulting from uncontrolled cutting by the African populations and from unrestrained exploitation will have to be counteracted by controls, by progressive changes in agricultural practices, but, above all, by proper silviculture. This must be achieved either by introducing management of the forests being exploited or by undertaking improvement work in reserved forests. Purely protective measures need to be fairly limited in scope and confined to the mountain regions and the area bordering the savannahs.

The importance of the open formations cannot be denied but their degree of usefulness is debatable. It can be assumed that the presence of forest stands causes an increase in rainfall, atmospheric humidity, and the amount of water infiltrating the soil, and a decrease in ground evaporation. The forests of the Sudanese type are important to local populations as a source of supply for a number of products essential to their existence, but their general economic importance is of a much lower order. Some species, such as the *Khayas* and *Dalbergia,* produce beautiful woods, but the trees are often deformed; in any case, they cannot be exported profitably, since they grow in regions far from the coast. However, certain species of

Acacia tall grass savanah—grassland, Themeda triandra, *and acacia—in Kenya Colony.* (*Photo courtesy H. L. Shantz*)

real commercial value should not be overlooked, particularly the karite (shea tree), which provides a readily marketable oil seed, and the kapok, which supplies fiber comparable to the best plantation products.

The equatorial forest is not likely to disappear completely, but the Sudanese type formations may well disappear unless something is done immediately to save them. The two main dangers are clearing for cultivation and the annual burning which is highly injurious in all areas.

The forested steppe formations of the Sahel type have a major social significance. They cover vast territories and where they occur make possible the existence of nomadic or semisedentary tribes who depend on livestock. During the dry season, when the grass has totally disappeared, the thorny species compensate for the lack of rangelands because, by cutting branches ,the herdsmen can feed pods and foliage to their herds. The indigenous populations also make extensive use of other forest products, particularly oils and tan stuffs. The effect of these formations on the climate is probably small but their role in binding sands and protecting croplands is very great. Their economic value is negligible although they supply some of the timber needed by the nomadic tribes and firewood for the settled communities as well as the wood required by public utilities, especially the river navigation companies. Gum arabic constitutes a commodity of considerable value in certain territories, such as the Anglo-Egyptian Sudan, French Senegal, and northern Nigeria.

These formations that reach to the borders of the desert are in a way a rampart against further encroachment by the desert. For this reason, they should be protected, regenerated, and, if need be, reestablished. Since climatic conditions are particularly unfavorable for forestry work of any kind, it is certainly in these regions that the forest services will face the most thankless and arduous tasks.

Silvicultural Problems

To arrest and counteract the impoverishment of the dense forests by improving the composition of the growing stock and its economic value; to ensure the protection and the reforestation of the forest areas in the dry regions—these are the foremost silvicultural problems of Africa. They would be difficult enough in highly developed countries, but in Africa, the enormous areas and distances and the difficulties of access make them infinitely more complex. Tropical silviculture is still in its early stages; its techniques have to be perfected and varied according to the composition of the stands, climatic conditions, and even local customs and populations.

Forest services and forest legislation in the various territories had to be created from scratch. It soon became evident that the initial requirement was a complete inventory of forest resources together with a thorough knowledge of the country and of local habits and requirements. The first step, therefore, was the making of botanical forest surveys, followed by the establishment of experiment stations to perfect silvicultural methods. On this basis it became possible to enact adequate regulations and to formulate and carry out work programs. Mention should be made of the men who pioneered this work, notably Thomson of Nigeria among the British; Jentsh, a German; the Belgians, de Wildeman, Delevoy, and Tondeur; and Auguste Chevalier, Aubréville, and Humbert among the French.

The preliminary work is now progressing satisfactorily in most areas. In some, inventories have already been completed, and practical forestry measures can now be undertaken by the forest services.

Forestry in the Dense Equatorial Zone

It has already been pointed out that except in certain instances, the existence of the great tropical evergreen or rain forest is not seriously endangered and that the only problems which arise are those of arresting and counteracting the impoverishment of its stands and of increasing its economic value. The solution to these problems must be sought through silvicultural, agricultural, and legislative measures.

Foresters at first attempted to base their silvicultural activity on legislative measures alone since they lacked the personnel, equipment, and money to undertake any effective action along other lines. In the French territories, the "Bertin Rules" were a sample of this, but they soon proved ineffectual because of the difficulty of supervising their application.

There are two major schools of thought on African silviculture at the present time. The older is concerned only with the exploiting of certain well-known species, which have already been marketed commercially. It advocates intensive silviculture under the direction of the administration, the work to be concentrated on very small areas of "productive" forest reserves and carried out by competent technical personnel. Control over the rest of the forested area, which is economically of great value, is not abandoned but is limited to a strict regulation of the user rights of the people. A new trend, however, has recently become noticeable. In fact, it is a revival of the work of foresters in the Far East and even in Africa who recommended extensive silviculture, based on the utilization of a very large number of species. In such cases, the harvesting operation itself constitutes the actual basis of the silvicultural treatment. In order that the stands be affected as desired, it is essential that the cut should be sufficiently heavy and spread over a great number of species and size-classes. For this purpose a wide range of species must be commercially acceptable or at least be suitable for local utilization. For very sparsely populated regions—and there are many in Africa—such an intensive utilization is possible only if important woodworking industries exist or can be established locally. These industries should be fully integrated and capable of absorbing practically all kinds of wood. The industries will have to subject themselves to extremely strict cutting regulations, based on control by area, and in particular they will have to harvest within stated periods of time specified quantities of each species or of each of the major groups of species.

Legislative measures and regulations must therefore be closely related to the silvicultural methods decided upon. Those now in force first establish the ownership of the forest, whether by the State, the colony, the province or, sometimes, by the local community or by private individuals. The rights of usage of the people are laid down, since it is their abuse that has been most harmful to the forest in the past. Utilization rules still vary widely according to countries and the type of industry and product desired.

Most countries are at present studying ways of modifying and improving the ancient practices of shifting cultivation and nomadic grazing. The effect of the farming demonstrations at Yangambi shows that some countries have already achieved interesting results in this field.

Forestry in the Savannah Zone

It is difficult to speak of work in the African savannahs as forestry. For the most part, foresters have to deal with vast open lands, which are sparsely timbered, have no stated ownership, and, what is more, are of very little economic value, so that the administrative authorities are inclined to pay very little attention to them. The practical difficulties of forestry work and the cost of silvicultural operations are heightened by the extremely unfavorable climatic conditions. Foresters consequently have had to proceed along even more extensive lines than in the dense equatorial forest areas, and their primary activity has consisted in determining and protecting the richer and more favorably situated forest stands.

In the Sudan-type zone, protection has to be afforded primarily against the devastating annual fires. The clearing of land for agricultural purposes is still carried out by burning, but as the fire is not controlled, the damage is out of all proportion to the object to be gained; excessive cutting on the other hand is relatively unimportant. The reserves which have been established are therefore merely areas protected by fire lines which surround and divide them, prevent destruction by the annual fires, and thus permit the original vegetation to re-establish itself. Sometimes it has become necessary to resort to artificial planting for climatic reasons or to ensure a supply of wood to settled communities, industries, and public or private utilities.

Techniques for the reforestation of savannahs were unknown at the beginning of the century but have made great progress since 1930 as a result of the work of the experiment stations where adequate methods have been developed and hardy and rapidly growing species chosen that are suitable to the climate of the regions. The two great enemies to planting are the grass that means fire during the dry season and threatens to stifle the young plants in the first years of their life during the rainy season and, above all, the climate. Tree species have to be of very rapid growth in their early stages in order to be sufficiently developed to endure the first dry season. Silvicultural experiments have shown that there is no hard and fast rule in this respect and that, depending on the species and the local climate, it is sometimes best to plant stumps, sometimes half-grown plants and sometimes to undertake direct sowing of seeds. In the majority of cases the need for mixing crop cultivation with tree planting has been demonstrated and this practice has proved to be the surest as well as the most economical. Among the species that have proved most satisfactory are cassia, teak, the albizzias, etc.

In the formations of the Sahel type it is more difficult to fight deforestation because the stands are in an even more unstable state of equilibrium than in the Sudanese zone. However, some basic work is urgently needed in these regions because deforestation results in the progressive transformation of the land into desert and thus ultimately renders vast areas uninhabitable. The principal danger is overgrazing. Brush fires are infrequent because the ground cover is irregular and the clearing of forest lands for cultivation over large areas occurs only rarely, except on the borderlands of this zone. Where they do occur, it is usually due to the introduction of large-scale cultivation advocated by the administrative authorities, whose obvious duty must therefore be to do everything in their power to remedy the harm they have caused.

The peoples living in these regions are generally nomadic and live by cattle raising and the harvesting of such products as gum. The flocks graze on the savannahs and destroy the natural regrowth of vegetation so that the stands become too open and, what is more, over-aged. They also suffer from the excessive cutting of branches for feed purposes. Whereas in certain regions, such as the Anglo-Egyptian Sudan, the tapping of gum trees is practiced correctly, in many others, in Mauritania and Senegal for instance, the trees are tapped too heavily and too frequently. It is imperative to check this abuse but, in the semi-desert regions, with their wild nomad tribes, the problem is very often more political than technical, and too strict a control might cause an exodus to other more tolerant territories, and sometimes even provoke actual revolt. What was undertaken, therefore, on those territories having forest services, was the systematic setting aside of the finest forest stands as reserves. These reserves have been freed of all rights of user and outside them the exercise of rights is regulated.

In certain instances, and particularly with respect to gum tree stands, such methods have proved inadequate. It has been found essential to rehabilitate the forests and restock them. In some regions it has been found necessary to resort to actual planting in order to produce wood for domestic or industrial purposes. On the whole, however, the results have been poor, especially as regards the financial return from the operations. It has nearly always been necessary to water the seeds and young plants during the first dry season and consequently the expense has been entirely out of proportion to the results obtained. A few interesting projects have been developed on French territory (in Senegal, Sudan, and the Niger) and a rational plan has been drawn up for reforestation in Northern Nigeria. In 1937 an Anglo-French mission, whose purpose it was to combat the gradual advance of the Sahara desert, conducted a wide field survey and recommended certain measures, several of which were applied successfully.

Forestry in the Mountain Regions

Sometimes, the forestry situation in mountain regions is serious. The forest is often in an advanced state of deterioration, and this has far-reaching effects on the economic life of populations of the mountains and the plains. Extensive silviculture is possible, of course, but no quick results can be achieved. Here intensive silviculture is more advisable, in view of the climatic conditions which are particularly favorable both to indigenous and to exotic conifers. In Kenya, for example, excellent results have been obtained from plantations of cedars, *Juniperus procera*, pure or mixed with *Olea chrysophylla* and silver oak, *Grevillea robusta*, and also from plantations of exotic trees such as *Cupressus macrocarpa*, *Lusitanica* and *Grevillea*. At altitudes of 2,000 to 2,500 meters, *Eucalyptus glo-*

Log extraction road in the equatorial forest of the Gold Coast. (Photo courtesy of British Information Service.)

bulus, ***E. saligna*** and ***E. maculata***, have also given good results. Plantation experiments with pure stands of pine from Indochina have been undertaken in French Guinea and in the mountains of the Cameroons. Elsewhere *Grevillea* and *Podocarpus* are used along with native broadleaved trees.

Forest Production

The two figures needed for an estimation of the potential forest output of a country are the surface area of the forest stands and the potential productivity of the forests per surface unit; these are difficult to obtain in Africa since only an infinitesimal portion of the forests has been explored, surveyed, and recorded. The problem is further complicated by the fact that absolute figures for Africa are of practically no value since they can only represent a "theoretical" potential production. In fact, under present-day conditions merely a fraction of the forests can be considered as economically accessible, and only a very few of the numerous species constituting these stands as technologically and commercially utilizable. Conditions, however, may change rapidly as nearly total utilization of large forest tracts is being envisaged.

Utilization Possibilities of the Wooded Savannahs

With regard to the possible utilization of the "dry forests" often classed as nonproductive, Aubréville has pointed out that the quantity of wood which can be extracted per hectare today varies considerably in these forests. The best wooded savannahs, those at Isoberlinia and Uapaca, can supply a maximum of 140 steres per hectare, which is equivalent to approximately 70 tons of wood. He allows as an average figure, 20 tons per hectare. Moreover, he is of the opinion that these stands could easily be worked as coppice, on a 20 years rotation, and that they would then produce 20 tons per hectare. An annual potential production of one ton of wood per hectare could therefore become possible for the Sudanese type savannah zone hitherto considered unproductive. If the stands in this zone were protected against brush fires and managed properly, they might then become an important source of forest products. At present it is believed that the extraction of wood under license amounts to only the two-hundredth part of this possible production, even though this was set at a very cautious figure. Account must be taken of local wood consumption for heating and housing purposes, but this could not be higher in these sparsely populated areas than one ton per inhabitant per year.

In view of the important part played by these wooded savannahs, from the general point of view of climate, soil protection, and water conservation, some foresters are against their utilization for fear that they might disappear. In fact, however, the danger of the destruction of forests through exploitation is less than that from brush fires and clearing for cultivation, for instance. It is difficult as yet to combat these destructive practices since the woods are considered to be of no economic value and their stabliizing role in the bioclimatic and bio-edaphic equilibrium of these regions is not sufficiently recognized. If, as a result of the creation of industries, these woods, hitherto considered useless, should acquire an economic value, so that proper forest management could be introduced, this would not only lead to their improvement, but also make it considerably easier to combat the main causes of deterioration. As Aubréville puts it in concluding one of his reports, it is sometimes necessary to find uses for the timber in order to save the forest.

Except for the question of manpower and the problem of transportation of the products, for which there is no easy solution, because of the distances from the coast, the exploitation of these savannah woodlands offers no serious technical difficulties. It is obvious that the wood should, as far as possible, be processed on the spot, and, except for local requirements, not be processed mechanically. The great equatorial forests are a far better source of supply for the mechanical industries whereas the species growing on the savannahs are by size and technological characteristics better suited for utilization by chemical and semi-chemical industries.

Utilization Possibilities of the Dense Forest

It is a fact that the dense forest zone of Africa constitutes one of the great wood reserves of the world. Estimates of the volume of standing timber in the great equatorial forests vary from 300 to 800 m^3 per hectare. The wide discrepancy between these estimates is due to the variations in stand and the fact that some are based on all species found in the forest whereas others take into account only the trees considered of value as timber. Reliable authorities grant an average figure of 400 m^3 of timber and 200 steres of firewood, a low figure leaving a safe margin. In order to get a rough idea of potential production, the figure of 400 tons of wood per hectare for standing timber would be a fair estimation.

Calculations and measurements have been made in order to determine more accurately the cubic volume of standing timber and the potential output of Africa's equatorial forests. The interpretation of each set of results can nevertheless give rise to a certain amount of criticism. Calculations made in the Cameroons based on a list of 40 species which can be used for sawn goods, and about 15 of which are already used commercially, have given the following figures: for the volume of mature timber, that is to say, trees which have attained the proper diameter for felling, 35 m^3 of wood per hectare (28 tons of an average density of 8.8) for primary forest, and 20 m^3 (14 tons with an average density of 0.7) for second growth. It has been further estimated, on the basis of surveys carried out in the Ivory Coast, that for trees having a diameter of between 30 and 60 centimeters, the average rate of growth in volume is 4 percent and that consequently the replacement of the forest capital from the middle age classes (i.e., trees with a diameter between 30 centimeters and the required felling diameter) is possible within 50 years, even if it is assumed as a margin of safety that during this period half the trees will be either damaged or destroyed.

It would therefore be possible, according to these calculations, to predict an output somewhere around 15 m^3 per hectare annually, if all species were used, for all accessible parts of the equatorial forests. This cut could be repeated after an interval of 50 years and could thereafter be continued for at least a hundred years. Elementary forest management of these areas would lead, on this basis, to a considerable output, without depletion of the growing stock.

Exploitation of these forests began in the early part of the twentieth century but did not develop to any considerable extent until about 1910.

There were primarily three major groups of hardwood species which were commercially exploited, namely: mahogany, okoumé, and limba. The exploitation of other species which are often grouped under the heading of "miscellaneous woods" assumed a growing importance in certain territories, and the

development plans which are being drawn up at the present time are based primarily on increased production of these woods.

The apparent differences between countries of fairly similar conditions, particularly as regards total output and the proportion of sawlogs to total production, are due to variations in the method of estimating fellings for local consumption. Figures are obviously incomplete. Exploitation for export was never very great, for reasons given later, but it has constituted a stable and important part of Africa's economic life, as is shown by some export figures.

TABLE 1.—ANNUAL FOREST OUTPUT OF AFRICA[1]

Country	Total round-wood	Soft-woods	Hard-woods	Total output of saw-logs and veneer logs
	(Million cubic meters)			
ESTIMATED TOTAL	50.0	1.0	49.0	4.00
Angola	0.5	—	0.5	0.07
Bechuanaland	0.8	-	0.8	0.01
Belgian Congo	2.5		2.5	0.45
Eritrea	0.1	*	0.1	0.01
French Cameroons	3.7	. .	3.7	0.15
F. Equa. Africa	10.2	. .	10.2	0.20
F. West Africa	0.8	—	0.8	0.13
Gold Coast	3.7	.	3.7	0.25
Kenya	1.0	0.1	0.9	0.17
Madagascar	0.2	—	0.2	0.02
Mauritius	0.1	*	0.1	0.02
Nigeria	0.6	—	0.6	0.28
N. Rhodesia	0.3	-	0.3	0.11
Nyasaland	2.8	*	2.8	*
Seychelles	0.1	0.1	—	.
Sierra Leone	2.7	—	2.7	0.01
S. Rhodesia	2.1	*	2.1	0.07
Tanganyika	0.4	*	0.4	0.11
Uganda	0.3	*	0.3	0.12
Union of S. Africa	2.7	0.7	2.0	0.72
Zanzibar	0.2	—	0.2	—

*Small.
[1]Excluding North Africa. Data by countries are official statistics reported to FAO and published in the Yearbook of Forest Products Statistics, 1947 and 1948 editions. The total is an estimated total.

There are several reasons for the partial failure of successive efforts to develop forest production in Africa. In the first place, since the stands are of very mixed composition and of relatively poor quality, it was necessary to adopt the practice of selective cutting with its high cost of extraction. This, added to high transportation cost, often made selling prices prohibitive, and exploitation, therefore, had to be limited to special and precious woods which did not compete with local woods in other countries.

The amount of utilizable, or rather marketable woods, was thus restricted from the outset; costs were high and the limited markets rapidly became glutted. As soon as utilization reached a certain level and any sizable quantity of these woods was offered for sale, disposal became difficult and very often the prices obtained were ridiculously low in relation to the value of the wood and the efforts of the firms engaged in extraction. There was a consistently large demand only for okoumé, but its production was limited for silvicultural reasons to a figure of 300,000 tons per year.

Under the original utilization conditions, it was always difficult to maintain a balance between production and consumption. This was one of the main concerns of the administrative authorities of the more important forest territories, as well as of the timber firms themselves, and failure to expand the African forest industries cannot be attributed to wrong methods but rather to an insufficient demand for tropical woods.

The principal cause for the high costs just mentioned is the relative poverty of tropical forests. Costs could be considerably reduced if the range of marketable species were enlarged. Experts, however, have always had considerable difficulty in getting trade and industries to accept new woods. There are several reasons for this, principally the technical difficulties of utilizing certain common species because of their properties which range from one extreme to another: that is, either extreme hardness or complete lack of resistance to attack or decay. Shortage of industrial plants and of sawmills in particular, and lack of adequate experience in working, processing, seasoning, drying, and preserving certain woods compelled the elimination of many common softwood species, with the result that only semi-hardwoods, hardwoods and sufficiently resistant softwoods were used. It should be further kept in mind that although

TABLE 2.—1947 TRADE IN AFRICAN HARDWOOD SAWLOGS AND VENEER LOGS
EXPORTS BY DESTINATION

Destination	Exporting Country					
	Gold Coast	French Equatorial Africa	Belgian Congo	Nigeria[1]	French West Africa	French Cameroons
	(Thousand cubic meters)					
TOTAL	148	†213	†75	64	[2]60	37
Europe	*89*	*187*	*68*	*61*		*32*
Belgium		5	51	—		3
France		83	—	—		14
Netherlands	—	12	5	—		5
Switzerland		19	—	—		
United Kingdom	89	55	8	61		5
Other countries	.	13	4	*		5
Near East and North Africa		*2*	—	.		—
North America	*59*	*11*	*1*	*1*		*2*
U. S. A.	59	8	1	1		2
Other countries	. .	3	—	—		
Africa	.	*12*	*5*	*2*		*3*
Union of South Africa	—	12	5	2		3

†Total does not exactly correspond to the sum of the listed figures which have been rounded off.
*Less than 500 m³ (r).
[1]1946 data.
[2]Distribution by countries of destination not available.

some of the woods have admittedly poor mechanical or technological properties, the reluctance of buyers was also due in great part to conservatism.

Possibilities of Developing Forest Production

The reasons for past failures are now well known, and experts realize what to avoid. Great technical progress has been made, particularly as a result of research on tropical woods carried out in the laboratories of Princes Risborough, Nogent-sur-Marne, Gemblou, Yale, in the colonial experiment stations, and also by industrialists and timber firms. To mention but one example, the limba of the Belgian Congo, for a long time considered unsuitable because of its lack of resistance to attack by insects and fungi, is now being treated with preservatives in ways that are both effective and economical so that it now commands an excellent position on European markets.

Wood requirements throughout the world have now increased, and the time is ripe for renewed efforts to expand African forest production, this time with every chance of success. It has been pointed out that one of the main obstacles to the introduction of new species on the markets was the conservatism of commercial and industrial users; full advantage should therefore be taken of periods of shortage to overcome this reluctance.

Utilization of the great African forests, which is desirable for both economic and social reasons, should be comparatively easy at this time. The fundamental ideas on which development plans are being based are roughly the following: First, the number of usable species should be greatly increased, primarily by a wider use of species with soft wood which can replace conifers for certain purposes; thus, selective cutting of only a few species will give way to rational and more economical exploitation because costs will be distributed over larger tonnages. Second, local processing industries, particularly sawmills, plywood factories, pulp factories, etc., should be introduced, again with a view to reducing prices but also for the more direct reasons of satisfying local requirements and conserving the forest. Finally, highly mechanized extraction and converting methods should be instituted in order to avoid waste of scarce and costly manpower.

One of the major obstacles to development at the present time is the lack of equipment or, what amounts to the same, the lack of foreign exchange to purchase it. Despite these temporary difficulties territories such as Nigeria, the Cameroons, Gabon, and the Belgian Congo are being gradually industrialized.

There are great areas in the north and south of this continent which lack forest resources. These are important wood consumers which will provide natural and stable outlets for this great potential production. As it develops, Central Africa will also increase its consumption and absorb more and more manufactured products. Finally, important foreign markets are already open, thus giving Africa the possibility to contribute, as it should, to abundance and stability in the world wood market.

Loggers riding logs being towed behind power boat on the Ivory Coast. (Photo courtesy Service Intercolonial d'Information et de Documentation)

Forestry Research and Education in New Zealand

By THOMAS T. C. BIRCH

I. Development of Forestry Research in New Zealand

RECOGNITION of the importance of organized forestry in New Zealand culminated in 1920 when a new Department — the State Forest Service — was formed and given statutory and administrative authority by the Forests Act, 1921-22. The initial recommendations of the first Director of Forestry included the statement that "the formation of a strong research division is absolutely necessary if we are to make any advance in the solution of the forest problems of New Zealand." Unfortunately action on this recommendation was deferred and, with a few marked exceptions, forestry research in the Dominion during the last 28 years can only be described as sporadic; the chief reasons for this were the inadequacy of trained staff, financial stringencies of a world depression, and the inevitable disruptions of a world war. Despite these handicaps, the quality and quantity of research accomplished cannot be regarded as unsatisfactory.

The pioneering work of Dr. Leonard Cockayne on the botany and ecology of the indigenous forests was of the highest quality and remains the basis upon which subsequent indigenous research has developed. Throughout the early years of its development the Forest Service has established many experimental plots of diverse character in both exotic and indigenous forests, while in more recent years fundamental research has been carried out on seed crops, viability of seed, and growth cycles of commercial species. In the field of forest utilization, much applied research has been undertaken and the results have already been incorporated in everyday wood-using technique and practices. The development of national grading rules for building timbers and the wide adoption of kiln-drying schedules are examples of outstanding results from applied research.

For 20 years the Forest Service operated on a broad organizational basis, with its small staff concentrated chiefly upon administrative reforms and practices in indigenous timber sales, and upon large-scale exotic forest establishment. Administration was, as now, decentralized in the seven Conservancies representing major territorial charges, but neither in these nor in the central office of the Director of Forestry was sufficient specialization developed to warrant a more detailed organization.

With the appointment of a number of qualified forest officers in 1939/40 it became possible to plan for the development of work on a divisional basis, but this reorganization was delayed until 1946 when five basic divisions were established. At that time the co-ordination and control of staff recruitment, training, and research, were vested in the new Development Division.

As a direct result of this reorganization, provisions were made to place research on a permanent basis, and in 1947 a Forest Experiment Station was established in Rotorua. Still very youthful and in process of expansion and consolidation, this national Experiment Station has, nevertheless, been well founded and is at present actively engaged in initiating and co-ordinating many short-term research projects, and in developing a long-term research policy. The present nucleus staff includes nine professional officers; but the immediate establishment provides for three times this number, and steps are being taken to obtain the additional staff in the early future.

The objective of the Experiment Station is to initiate, supervise, and co-ordinate all forest research work carried out in the Forest Service. Its activities are based on the principle of close co-operation with the staffs of the Conservancies which are expected to make local investigations under the indirect supervision of the Experiment Station. The Station is subdivided into four branches, Botany and Silviculture, Management, Pathology, and Forest Products, under the direction of an officer-in-charge, who is linked administratively with the Development Division, the headquarters of which are at the office of the Director of Forestry in Wellington.

The National Forest Survey

Initiated a year before the establishment of the Experiment Station, but now a function of that organization, the National Forest Survey is the most outstanding current investigation. The main objectives of this Survey are:

(1) To estimate the volume of available merchantable timber in the remaining non-protection indigenous forests, the estimate to be by major regions, and within each region by species and diameter classes.

(2) To revise existing national forest inventory estimates in order to obtain more accurate figures for individual forests and minor land subdivisions.

(3) To prepare vegetation maps for all classes of forested land, based on the broad vegetation and volume-per-acre classes.

(4) To survey the extent and degree of natural reproduction of forest and the extent and nature of deer and other animal damage, to superimpose land ownership boundaries on the vegetation maps, and to survey all types of non-commercial and protection forests.

The methods used depend largely on vertical air photographs (scale of 1:16,000) from which accurate acreages can be obtained without detailed ground surveying. The ground-sampling phase of the survey has been designed on a statistical basis and definite standards of accuracy have been set. The final results, which will not be available for several years, will be of known and acceptable accuracy and will form the basis of the Dominion's timber-use economy for at least the next 50 years.

At the Rotorua Forest Experiment Station, a national herbarium for both indigenous and exotic forest species is being built up, largely from material collected by officers engaged on the National Forest Survey. An exotic forest arboretum established in 1900 in the vicinity of the Experiment Station is being maintained and expanded to include both exotic and indigenous species.

Characteristic research problems engaging the present attention of the New Zealand Forest Service in general and the Forest Experiment Station in particular are reviewed briefly under Sections III, IV, and V.

II. Development of Forestry Education in New Zealand

The various administrations responsible for New Zealand's forests have had opportunities to learn much from past errors and omissions. Perhaps the greatest lesson, only recently learned, is that little real progress can be made until there is sufficient trained staff to manage commercial forests intensively and at the same time carry out without interruption a research program primarily designed to improve and extend such management.

Much has been done since the last war towards achieving this combined objective. Prior to the war, higher forestry education was provided by the University of New Zealand at two Colleges for a brief period but was discontinued during the depression, partly because of failure to recognize the national importance of maintaining one institution providing adequate facilities for both education and research instead of two inadequately equipped schools.

Lack of general recruitment during the prewar decade following the depression, and the absence of young graduate foresters in particular, created serious gaps in the cadre of Dominion foresters in both executive and research capacities. To meet this staff emergency, the Forest Service adopted, towards the end of the war, a long-term plan for the regular recruitment and training of apprentices and all other grades of forest officers. One outcome of this policy decision was the annual recruitment of some 20 carefully selected youths; a small proportion of whom were provided with facilities to study for a basic science degree (B.Sc.) as a prerequisite to higher forestry education, the reinstitution of which the Forest Service is vigorously advocating. The recruitment and training policy was not, however, confined to staff apprentices, and in 1944 a departmental Training Centre was established at Rotorua (in the same location as the future Forest Experiment Station) and within the organization of the Development Division.

Since its establishment, the Training Centre has provided a continuous series of short courses for workmen, and for clerical and field officers. These courses are designed for recruitment, refresher, and promotion-qualifying purposes. The results achieved have gone a long way towards meeting the acute current staff shortage. They have also established a successful precedent for a more ambitious forestry educational plan to provide professional and subprofessional training in intimate association with the Forest Experiment Station.

In 1938 and 1948 the key field staff of the State Forest Service (excluding clerical and specialist officers) was:

	1938	*1948*
Graduate Foresters	6	34
General Division Officers (all grades above and including Forest Rangers)	70	126
Totals	76	160

The number of foresters is still inadequate, but the increase since 1938 has made possible a move towards more intensive management of national forests and a greater emphasis on research. An exceptionally vigorous policy of both internal and overseas recruitment has achieved these results and only now, in the continuation of this policy, is the forestry authority of this Dominion able to look forward with some degree of optimism to the gradual solution of the many outstanding problems in both indigenous and exotic forests.

III. Research Problems in the Indigenous Forests*

Enquiry into the fundamental nature of the indigenous forests of New Zealand and their capacity for permanent yield management has largely been sterile of significant results. In the first place, the most urgent requirement was not to maintain the forest but to replace it by productive grasslands and to maintain these grasslands. Secondly, much of the work that was carried out was vitiated by too rigid adherence to the concepts of overseas ecologists and silviculturists without critical enquiry into the local applicability of such ideas. The wholesale adoption of European and American terminology and theory delayed technical advance, a delay aggravated by faulty liaison and lack of mutual understanding between botanist and forester. Botanists have tended to supply blanket theories to "explain" all podocarp forests, or all *Nothofagus* forests, while the foresters, because such theories obviously were inapplicable to particular forests, rejected the explanations, regarded the botanists as impractical theorists, and resigned themselves to a simple empirical approach. This approach has

*Contributed by John T. Holloway, Forest Experiment Station.

yielded much information of value, particularly as concerns the *Nothofagus* forests. Progress has been slow, however, mainly on account of perennial labor shortages and lack of trained staff—handicaps rendered more serious by the almost complete absence of any market for minor forest produce, and by popular relegation of permanent forests to areas remote from centers of population.

The extent to which the foresters' findings and the botanists' theories can be applied is not yet known. Progress now hinges upon re-examination and supplementation, assisted by air survey, of the descriptive data, upon reinterpretation of the facts, the correlation of theory and practice, and the initiation of wider scale field experiment directed in accordance with up-to-date, local findings.

Recent work suggests that the indigenous forests of New Zealand have been in an essentially unstable condition since the date of European settlement a century ago. Their distribution does not reflect present climatic conditions but the climate of a warmer and more humid period. In particular, the bulk of the softwood podocarp forests display symptoms of overmaturity and stagnation with a virtual absence of young growth. The economy of the timber-producing industry demands that utilization of such relict forests be intensive to the point of full exploitation. The consequent destruction of microclimates prohibits the re-establishment of the original type of forest under the present regime. The second crop consists mainly of worthless and malformed hardwoods. The podocarp forests seem vigorous only on special lowland soils, and it is only on these soils that adequate regeneration can be secured; but these same soils can be converted to high quality dairying pastures and they must be utilized for food production. The podocarp species is also intractable to normal forest nursery and reforestation practice. No reliance can be placed upon the podocarps for permanent yield of softwoods. They are restricted to sites where local conditions are particularly favorable and where the land

An experimental pressure-creosoting plant at the State Mill, Rotorua. The posts are larch, Larix decidua.

ORGANIZATION CHART
NEW ZEALAND STATE FOREST SERVICE

is not required by the farmer. Podocarp forest research must be designed to delimit such areas; more urgently, it must aim to divert the forests following logging away from the scrub hardwoods toward more valuable species. In many cases these species may have to be exotics.

The hardwood *Nothofagus* forests present a less difficult problem. At least five species of *Nothofagus* are involved, but the accurate determination of these and of their many hybrids has not been achieved by the taxonomists. All of the species, however, have more favorable silvicultural characteristics than any of the podocarps. For these forests also, the major problem is to determine where the various species exist by virtue of present climates and where they are survivors from the past; it is only in the former that management problems are likely to be solved satisfactorily. Each species varies widely in its site requirements for different phases of its life cycle. For example, conditions favorable to regeneration of a species are not necessarily the same as those which promote rapid growth or optimum size at maturity. Within the virgin *Nothofagus* forests rapid readjustments of species to site are in progress while *Nothofagus species,* wherever such forests are contiguous with or contained within podocarp forests, tend to extend their area at the expense of the podocarps. Permanent management of the *Nothofagus* forests depends upon recognition of the areas in which the desired species are aggressive and selection of sites within those areas where regeneration, growth rates, and form are good. Under present conditions the species which is now considered of least value is aggressive over wide areas. Successful management will depend here upon the development of a suitable market. For each species, within its optimum range, silviculture is likely to be similar to that employed for *Fagus sylvatica* in Europe.

The third major problem facing the indigenous forest research worker in New Zealand is that posed by

deer, wapiti, opossums, pigs, goats, and cattle which graze in the forests unchecked by the presence of any predators. If the forests are regarded simply from the point of view of timber production, the result appears beneficial since the preferred food plants are mainly silvicultural weeds. Unfortunately once these weeds are eliminated the major species are browsed on or otherwise damaged. In areas where the existing forest is unstable, changes are accelerated. Elsewhere the final result cannot be forecast since the virgin forest canopy is still intact. This problem is particularly serious: the greater part of the forests affected are watershed protection forests of mountainous terrain with high rainfall, the country as a whole is dependent for power on its hydroelectric resources, and agricultural production is concentrated on the flood plains of the rivers.

It will take some time to arrive at the solutions of these various problems; but the work should proceed more quickly now that well-defined research projects are under way, and the limited technical staff can be used to better advantage.

IV. Research Problems in Exotic Forests*

New Zealand's exotic forests cover some 344,000 hectares (850,000 acres), more than half of which is State Forest. The most important species is Insignis pine, *Pinus radiata*, which occupies 63 percent of the total area; others represented in large quantities are Corsican pine, *Pinus nigra*, lodgepole pine, *Pinus contorta*, western yellow pine, *Pinus ponderosa*, and Douglas fir, *Pseudotsuga taxifolia*. Less important species which have been successful on certain sites are European larch, *Larix decidua*, redwood, *Sequoia sempervirens*, western red-cedar, *Thuja plicata*, Lawson's cypress, *Chamaecyparis lawsoniana*, Monterey cypress, *Cupressus macrocarpa*, white pine, *Pinus strobus*, and the southern pines, *Pinus palustris*, *Pinus caribaea*, *Pinus taeda*, and *Pinus echinata*.

The major problem in exotic forestry is a management one which arises from the extreme maldistribution of age-classes and the preponderance of the one species *Pinus radiata*. The problem would be more easily surmountable if the forests were normal in other respects. Unfortunately they are not.

These forests were planted in the last 50 years, most of them during the plantation boom of 1923-1936. The earlier plantings were generally done carefully, with due attention paid to correct nursery and establishment techniques, to careful siting of species, and to the use of suitably close planting distances. Very little thinning, however, was done. On the other hand, during the boom period almost every silvicultural mistake was made. Not invariably, but too frequently, cheap seed was used, poor tree-stock was sent out from the nurseries, the planting technique was crude, and little attention was paid to maintenance. Furthermore the sites chosen were often very poor, an insufficient attempt was made to meet the site requirements of individual species, and the planting density was invariably 1,600 trees per hectare (640 trees per acre). Again no thinning was done. In this period of extensive forestry the emphasis was on quantity rather than quality and the costs in all operations were kept to a minimum. As a result, there is now a large area of low quality and understocked stands, badly distributed as to age-classes and species representation and exhibiting the greatest variability in tree type, tree form, and amenability to silvicultural treatment.

The immediate research program, therefore, must be directed towards efforts to improve unsatisfactory conditions during the first rotation. In the poorly stocked stands of fast-growing species there is little that can be done, except perhaps a high pruning and light thinning of those compartments which for one reason or another must be left to overmaturity. In the better stocked stands, and for the slower growing species the problem is how to catch up with arrears in thinning. The response to different grades of thinning at different ages and on different sites is in need of thorough investigation, as are the economics of thinning and the most practical means of carrying out the work. Since forest labor is expensive and in short supply the problem is as much one of administration as of research. The important questions are tactical in nature, e.g., for what species and on what sites will the limited labor force be put to best advantage? Already much is known. It has been demonstrated for instance that even 4′ x 4′ *Pinus radiata* will produce a high sawing yield with no thinning at all; and conversely that Corsican pine at a similar spacing will stagnate and not produce any trees of saw-log dimensions. To what extent thinning of other species and of Corsican pine at wider planting distances is essential rather than desirable is the question which the research branch must answer; and the answer must be accompanied by specific recommendations as to thinning grade and thinning cycle. The problem is rendered more difficult by the paucity of reliable sample plots.

The major research future in exotic forestry, however, is concerned more with the next and subsequent rotations of existing forests. Further, since New Zealand still has more than 400,000 hectares (1 million acres) of nonagricultural land that is climatically and edaphically suited to the growing of softwoods, the existing area may be considerably extended. The problems involved will call for a vigorous research program.

Investigations must be made of silvicultural characteristics, tree types, tending regimes, forest pathology, soils and soil relationships.

Silvicultural Characteristics. With the important exception of *Pinus radiata*, the main species used in New Zealand are well known in the countries of origin. Their silvical characteristics have been described and suitable silvicultural systems evolved. The results of overseas experience, however, are less useful than might be expected since most species behave differently and quite often quite unpredictably in this country. Much has been learned in New Zealand over the last 50 years but the information is fragmentary in nature and little has been collated or put on record. One of the major basic research projects, therefore, must be a detailed qualitative examination of all species as they grow in New Zealand. This work which is already under way will not only describe the individual tree characteristics, both morphological and phenological, and the normal course of stand development on different sites, but will also attempt to

*Contributed by A. Priestley Thomson, Officer-in-Charge, Forest Experiment Station.

Populus robusta, *planted in 1937, at Whakarewarewa, North Island.*

evaluate the optimum and limiting site factors, the effects of mixtures, and the conditions necessary for successful natural regeneration.

Tree Types. At least four of the major species used in New Zealand show marked variation in tree type. In Corsican, lodgepole, and western yellow pine the natural range of the species is wide and the types found in New Zealand are true geographical races. *Pinus radiata* on the other hand has a limited natural distribution and its variability must arise from other causes. In all species, site has a profound influence and often masks the inherent genetical characteristics. The first problem, therefore, is to determine the extent to which observed differences are genetic rather than environmental in character, and a series of progeny tests are envisaged. Concurrently, studies are being made to decide on the most desirable type for a given site and a given purpose. In most cases, type improvement must result from eugenic thinning practices, but attempts will be made to accelerate the process. Thus elite stands are being formed, research on the technique of vegetative propagation has been commenced, and plans are being laid for a program of work on controlled fertilization. New Zealand, incidentally, by reason of the fast rate of growth and early maturing of many species, offers a unique field for the tree breeder. As examples, lodgepole pine has been known to bear fertile cones at 5 years from seed, *Pinus radiata* at 6 years, *Pinus pinaster*, *Pinus muricata* and Douglas fir at under 10 years, and *Pinus patula*, *Pinus taeda*, *Pinus caribaea*, *Pinus nigra*, and *Pinus ponderosa* all at under 15 years.

Tending Regimes. As New Zealand's indigenous timber resources dwindle, increasing reliance will be placed on exotic species for all wood products. Hitherto, the public has not considered the exotic forests as a source of high quality timber. They have been invaluable, however, for supplying the local box and pulpwood industries and they have provided, from short rotation stands, a large quantity of low to medium grade sawn timber which is finding increasing use in the building trade. In the future they must replace the staple indigenous timbers, rimu, *Dacrydium cupressinum*, matai, *Podocarpus spicatus*, and totara, *Podocarpus totara*, as the primary source of building material. It is hoped that they will also supply a much expanded pulping industry. The two major objectives of management will be: (a) the provision of clean high-quality heart timber on a long rotation, and (b) the provision of heart-free pulpwood on a short rotation.

The research program will be directed towards the most efficient means of achieving these ends. Apart from further species and spacing trials, it will involve

a comprehensive program of permanent sample plot work designed to study the effects of different primary regimes, different thinning intensities, and different thinning cycles. As with all plantation work, the objectives will be to determine, for each species, for each site, and *for each object of management,* what original spacing distance, and what subsequent tending regime will be the most economical in producing the optimum yield.

Forest Pathology. By great good fortune, New Zealand's large areas of pure even-aged plantations are singularly free from any serious insect or fungal attack. Only in the worst instances of faulty siting have outbreaks of epidemic proportions occurred. Nevertheless the risk is always there. Research in forest pathology at the present stage is basic in nature and consists of studying the ecology and life cycles of the most important insects and fungi. Concurrently preventive measures are being studied.

Soils and Soil Relationships. Very little work has been done on the soils used for exotic forestry; in particular, their ability to meet specific nutritional requirements has received little study. Most forests show no signs of any mineral deficiency but an important exception is a group in North Auckland occurring on badly podsolized clays, known as "gumlands." Here soil is the limiting factor in healthy tree growth, and research in tree-soil relationships and in ameliorative measures will be necessary.

The pumice soils of the central volcanic plateau of the North Island are the most important soil group supporting exotic forests. They pose a soil problem which may become significant. Various pumice showers are represented, the most recent of which are basic in nature. These maintain their structure under forest cover and show every sign of continued fertility. On the more widespread acidic showers, however, a process akin to podsolization is rapidly developing. As in normal podsolization the tendency is for a black crumbly A horizon to be completely replaced by a structureless ash-grey layer. The mechanism is apparently far more complex than simple leaching and is thought to be due to soil fungi acting on the incorporated humus. What effects this process will have on future increment and what ameliorative measures (if any) will be necessary are the major problems on forest soils in New Zealand.

V. Forest Products Research Problems*

The approach to these problems in New Zealand, as in other timber-producing countries, has been along the lines of (a) fundamental research, and (b) applied research.

Fundamental research is concerned with the mechanical, physical, and chemical properties of timbers produced locally and, to a more limited extent, with timbers from adjacent islands. These timbers have been examined critically with regard to physical properties, i.e., density, shrinkage, peculiarities affecting seasoning, microscopical characteristics and identification, durability, working properties, and other general features which affect their use. The mechanical properties have been studied and comprehensive tests made of the more important basic strength properties of practically all the commercial timbers; the chemical nature of substances in a number of the woods has been the subject of the third important group of investigations.

Applied research in forest products has embraced those numerous problems concerned with technique in efficient preparation, marketing, and use of timber and other forest products. Typical of processes included under this heading are grading, seasoning, and preservation of timber. A reasonable approach to these matters must have regard for the fact that a great deal of work done overseas provides a useful guide to what is practicable and economic. Hence it has been possible to adopt some of those practices without substantial alterations. Studies of properties, included under fundamental research, enable comparisons to be made between local timbers and overseas timbers. In those cases in which resemblances are close, it is possible to indicate directly the potential uses for the timbers, the grades required for those uses, and the consequent method of sawing to produce the grades. It may even be possible to indicate kiln schedules which are suitable. As regards wood preservatives, there are many treating methods and preservatives which have been proved satisfactory; applied research will then involve comparison of service conditions as these are the determining factors in choice of treatment methods and specifics.

Attention has also been given to the wide range of forest products other than sawn timber and natural round or hewn or split products. Processes for conversion of wood waste apply to local timbers as to overseas timbers but economics have always to be considered very fully; this comment applies for instance to pulping processes, to wood alcohol manufacture, destructive distillation, fuel briquetting, and wood flour manufacture.

Forest products research in the future will give more emphasis to the planted forest species and to the native forest species which will continue to provide substantial quantities of timber.

A problem is created by the threatened exhaustion of indigenous softwoods in the not far distant future — certainly wood-using practices will radically change, even if these forests continue indefinitely to contribute a useful quantity. A few years ago over 80 percent of the local production of sawn timber was from the native softwoods, which are notable for their yield of exceptionally clean timber with a substantial proportion of heartwood of high natural durability, and for their remarkably close and even texture and consequent even-wearing. These timbers are also strong and show relatively little variation in density and strength; they are not highly decorative but yield good clear veneers; and, in addition to having the advantage of durability, the heartwood responds slowly to change in atmospheric moisture.

Today, the indigenous softwoods still comprise about 60 percent of the output, but the exotic softwoods are coming rapidly to the fore as the major general-purpose timbers of the future. They are lighter in weight than the native softwoods, contain numerous defects, are variable in density and strength, are very subject to decay and to shrinkage and swelling, offer some difficulties in painting, and do not compare favorably in certain respects with timbers they are, broadly speaking, destined to replace.

*Contributed by J. Stanley Reid, Engineer in Forest Products.

Nevertheless, they can be adapted very well to those purposes and therein lies an important aspect of timber research in New Zealand.

The ability of native hardwoods to regenerate naturally (such as *Nothofagus* species in particular) has stimulated research on their potential uses. For instance *Nothofagus cliffortioides* has been studied first of all from the anatomical angle to determine the relationship of its timber to the timbers of its sister species, its variability and the character of cellular inclusions. It was a natural step to link the silica concentrations shown by the microscope and chemical tests to sawing problems; the studies of variation of density and shrinkage, of strength properties, seasoning, grading, and uses follow naturally. Another hardwood, tawa, *Beilschmiedia tawa*, had been little used as a timber because of its many shortcomings in comparison with most other New Zealand timbers; improved seasoning, grading, and preservative treatment now place it in the high-quality white hardwood group.

In brief it will be apparent that forest products research will be increasingly related to forest management in the wide sense. This is exemplified by the specific gravity, shrinkage, and related studies which have been made to determine the effect of age, height, espacement, climate, and soil on the physical, mechanical, and chemical properties of timber from planted forest species (e.g. *Pinus radiata*). As a necessary corollary to such fundamental research will be the numerous applied research studies concerning timber grades, air-seasoning and kiln-drying technique, correct preservation practice, and extended utilization.

VI. Forestry Research Liaison

As private companies and local bodies control some 200,000 hectares (500,000 acres) of exotic coniferous forests in New Zealand, there is, as might be expected, considerable interchange of technical information mainly through Forest Experiment Station channels. Volume tables prepared by the Station have been made available to companies and the data obtained from private stands have been used to advantage by the Experiment Station.

There is considerable research liaison between the Forest Experiment Station and the Department of Scientific and Industrial Research whose Geological Survey, Soil Bureau, Plant Diseases, and Botany Divisions have provided valuable co-operation and have, in turn, benefited from observations and collections by National Forest Survey field staff, in particular. The Biometrics Section, also of the Department of Scientific and Industrial Research, acts in an advisory capacity in the application of statistical methods to current forest research.

In the field of forest products, there is liaison with the Dominion Laboratory (Department of Scientific and Industrial Research) in derived products, principally fundamental chemical research on wood.

High pruning of Douglas Fir, Pseudotsuga taxifolia, *at Rotorua, North Island.*

In furtherance of the standardization of national wood-using practices, including preservation, the Forest Service is represented on various committees convened by the Standards Institute which is a departmental organization functioning under authority of the Standards Act, 1941.

Close collaboration is maintained between the Soil Conservation and Rivers Control Council (a statutory body established by Act of Parliament in 1941) and the State Forestry Service through a full-time Forestry Liaison Officer. One of his functions is to represent forestry interests in soil conservation research.

The University of New Zealand (owing to heavy postwar teaching commitments and to limited staff) is at present doing little basic research in the biological sciences and consequently forestry research liaison is negligible. Considerable numbers of advanced students, however, seek forestry experience during vacations, and this is provided by the Forest Experiment Station (in particular by the National Forest Survey) to mutual benefit.

Photographs for this article were provided by courtesy of New Zealand State Forest Service.

Commodity Reports

Railway Sleepers

IT IS ESTIMATED that there are at present throughout the world about 1,250,000 kilometers of railway track for which approximately 3,000 million sleepers (crossties) are used, 95 percent of them made of wood. Since sleepers are heavy, bulky, and relatively cheap, they do not ordinarily comprise a large portion of the international trade in wood.

This article deals mainly with the present situation in Europe and in countries of the Near East. Generally speaking, importing countries in this area procure their sleeper supplies from the European and American markets.

Types of Sleepers

The term sleepers refers to the rectangular or approximately rectangular cross section supports laid transversely on the railway roadbed to support the rails.

Sleepers used in Europe are almost exclusively of wood and are manufactured either in sawmills or in the forest. Production at the felling site in the forest is gradually declining in importance as a result of the disappearance of skilled labor. Axe-hewn, squared sleepers, which are frequently used in the Americas and other parts of the world, are not produced in Europe.

Sleepers may be made of hardwoods or softwoods, these being used for different purposes and under different conditions. Hardwood sleepers are made chiefly from oak, beech, and hornbeam; softwood sleepers from Scots pine, maritime pine (*Pinus pinaster*), and larch. In Spain, eucalyptus is also used to make sleepers. Sleepers are usually cut from trees of 80 to 120 centimeters in circumference at a height of 1.30 meters from the ground, or from the tops and branches of large trees found in high forest or coppice with standards.

Standard gauge sleepers (1.46 meters) used in Europe may be classified into three different categories: German sleepers measure 16 cm. x 26 cm. x 2.6 m. or 2.7 m.; French, 14 cm. x 26 cm., and the same length; English, 12.5 cm. x 25 cm. These figures apply to sleepers sawn on all four sides. However, a certain amount of latitude is allowed for wane and curvature, there being three or four specifications. There are also the so-called "Swedish" or "Saxon" sleepers, where the upper and lower surfaces are sawn but the sides follow the natural contour of the rough log.

Switch or crossing ties vary in length from 2.60 m. to 5 m. or more; industrial sleepers are 1.80 m. to 2 m., and crossings generally 1.30 m. to 2 m.

The useful life of a sleeper depends upon its resistance to fungi, insects, and mechanical pressure. Protection against decay is obtained by impregnating with chemicals. The most widely used impregnating material is creosote, but solutions of copper or zinc salts are also used. By impregnation the useful life of a sleeper can be increased from 5-8 years to 25-30 years. Sleepers must have certain required mechanical properties. Damage to sleepers due to mechanical defects has become more frequent because both the weight of the loads carried and the speed of trains have increased. Such mechanical damage consists mainly in crushing, splitting, becoming imbedded, etc.

Since the end of World War II, impregnation plants in Europe have been restored to working order. However, chemical products, particularly creosote and sulphuric acid, have remained in short supply.

Steel sleepers have been used extensively in several countries, particularly in Germany and Switzerland. According to the Transport Committee of the Economic Commission for Europe, the demand for metal sleepers for the next few years will amount to 242,000 tons for Europe, excluding Russia. The manufacture of metal sleepers is simple and inexpensive. Since the total steel needed is not large, there should be no difficulty in supplying the demand. Metal sleepers were developed during a period of over-production of steel, when they were less costly than wooden sleepers. At present in Switzerland, metal sleepers, even when provided with insulation for use on electrified railroads, are still lower in cost than wooden sleepers. Metal sleepers, however, do not have the same elasticity as wood. They are noisy, and in the long run more costly, because the rolling stock has to be repaired more often. Finally, they cannot be used in close proximity to industries which give off vapors or gases which affect metals. In some countries, however, they can play an important role because of their resistance to termites.

Concrete sleepers have been used for a long time; their transportation is difficult, however, as they weigh two or three times as much as wooden sleepers. They are most widely used in Italy. During the last war, the United Kingdom experimented with a new type of reinforced concrete sleeper which seems highly satisfactory. They have been used there for the past five years and show no sign of wear. As a result, the United Kingdom is at present constructing a large factory for the manufacture of this type of sleeper.

Sleeper Market Between the Two World Wars

Data on international trade in sleepers between World Wars I and II can be found in the yearbooks of the Comité International du Bois, published first at Vienna and later at Brussels; in the publications of the International Institute of Agriculture, and in *Silvae Orbis*, referred to in Tables 1 and 2.

TABLE 1.—IMPORTS OF RAILWAY SLEEPERS

Country	1926-28 Average	1931-33 Average	1936-38 Average
	(..... *1000 m³ (s)* .....)		
Belgium-Luxembourg	67	38	84
Czechoslovakia	35	1	12
Denmark	24	15	6
France	16	76	8
Germany	411	17	69
Greece	5	7	6
Hungary	57	7	34
Netherlands	72	77	76
Spain	160	30	
Switzerland	7	2	1
United Kingdom	346	337	540
China	41	135	105
Canada	51	24	20
United States	94	37	32
TOTAL	1,386	803	993

SOURCE: Walter Grottian, "Die Umsatzmengen im Weltholzhandel 1925-1938," *Silvae Orbis*, Berlin: C.I.S., 1942, pp. 140-141. Computed from yearly figures.

TABLE 2.—EXPORTS OF RAILWAY SLEEPERS

Country	1926-28 Average	1931-33 Average	1936-38 Average
	..... *1000 m³ (s)*		
Austria	87	3	13
Czechoslovakia	30		2
Finland	16	1	7
France	119	28	93
Germany	49	34	3
Poland	364	157	255
Rumania	3	2	27
Sweden	47	19	11
Yugoslavia	281	80	90
Baltic States[1]	15	47	144
U.S.S.R.	96	282	186
Canada	115	67	92
United States	336	153	173
Turkey	9	1	.
TOTAL	1,567	874	1,096

SOURCE: Walter Grottian, "Die Umsatzmengen im Weltholzhandel 1925-1938," *Silvae Orbis*, Berlin: C.I.S., 1942, pp. 140-141. Computed from yearly figures.
[1]Estonia, Latvia, Lithuania.

During the period from 1926 to 1938 the United Kingdom was one of the major importers, importing 755,000 m³ (s) in 1930. Germany also appears to have been mainly an importing country. Its imports decreased considerably from 1931 to 1935, but rose again just before the war.

The principal exporting countries were Poland, Yugoslavia, the Baltic countries, Rumania, and Soviet Russia. The U.S.S.R. exported as much as 579,000 m³ (s) in 1930. The United States of America exported large quantities to the European market. France had some exports but was a net importing country. Its exports of hardwood sleepers went mainly to Belgium, with lesser quantities to the Netherlands and the French colonies; softwood sleepers were shipped principally to the United Kingdom and in small quantities to Spain, Belgium, Luxembourg, and the Netherlands.

European imports attained a maximum figure of 1,653,000 m³ (s) in 1930 and decreased thereafter. This drop in trade corresponds to a general worldwide trend. Sleepers constituted 2.5 percent of all timber exports in 1929 but only 1.9 percent in 1937.

INTERNATIONAL MARKET AFTER WORLD WAR II

During the war most European countries were unable to carry out much track maintenance or lay new railways. Consequently the sleeper market was quiet and countries attempted to supply their own needs from domestic production. Owing to shortages of chemical products, few impregnated sleepers were used.

Since the end of the war, there has been a great demand for sleepers, due not only to deferred maintenance requirements and the need for replacement of non-treated sleepers which have deteriorated rapidly, but also to the vast amount of destruction caused in the last year of the war by military action. Such destruction particularly affected France, Belgium, the Netherlands, Italy, and Soviet Russia, but there was also a considerable amount of damage in Africa, from Morocco to Egypt.

Requirements

Various international bodies which have dealt with timber requirements, particularly the Timber Committee of the Economic Commission for Europe, have recognized that the enormous potential demand for wood is limited by reduced production. Until recently, the supply of sleepers has not actually been short in relation to demand because countries have given priority to the purchase of other commodities. Once essential repair and reconstruction work have been completed, other rehabilitation of railway networks can be delayed. The useful life of sleepers can be extended by reducing the speed of trains and by other safety measures.

In July 1947, member countries participating in the Organization for European Economic Cooperation studied their sleeper requirements for the years 1948 to 1951. Participating ECE countries show a deficit in softwood sleepers throughout the entire period. The deficit in hardwood sleepers, however, will decrease from 651,000 m³ (s) in 1948 to 172,000 m³ (s) in 1950 and will disappear in 1951.

The United States Department of Commerce in the July 1948 issue of *Foreign Commerce Weekly* commented that, on the basis of 10 crossties per cubic meter, the requirements of participating countries from 1948 to 1951 amounted to 123 million crossties. Over the same period estimated production of the countries will approximate 72 million ties. Import requirements are therefore about 51 million sleepers. It then stated that it seems possible that the United States will be in a position to deliver from 8 to 10 million crossties during these four years.

The participating countries then must arrange to obtain the balance of their requirements of about 40 million sleepers from other sources.

The requirements of all European countries, except Spain and Portugal, have also been studied by the Transport Committee of the Economic Commission for Europe. For 1948 and subsequent years, sleeper requirements were estimated at approximately 3.8 million cubic meters. This figure is derived from Table 5, after some adjustments made by the Secretariat.

With respect to Spain, a published report by the U.S. Department of Commerce says that Spain's state railways annually require approximately 2.2 million

TABLE 3.—HARDWOOD RAILWAY SLEEPERS

Requirements and supplies of ECE participating countries and western Germany

Item	1934-1938	1948	1949	1950	1951
	(1000 m³ (s))				
Consumption requirements	1,117	1,911	1,529	1,365	1,181
Anticipated production and imports from overseas territories	986	880	644	643	644
Imports required from nonparticipating ECE countries	131	1,031	885	722	537
Estimated imports	131	380	450	550	537
Deficit	—	651	435	172	—

SOURCE: Committee of European Economic Co-operation, *Technical Reports*, Vol. II (July-September 1947).

TABLE 4.—SOFTWOOD RAILWAY SLEEPERS

Requirements and supplies of ECE participating countries and western Germany

Item	1934-1938	1948	1949	1950	1951
	(1000 m³ (s))				
Consumption requirements	1,415	1,661	1,557	1,552	1,552
Production	940	1,130	1,079	1,079	1,079
Imports required from nonparticipating ECE countries	475	531	478	473	473

SOURCE: Committee of European Economic Co-operation, *Technical Reports*, Vol. II (July-September 1947).

sleepers and private railway lines require approximately 600,000 sleepers. To this figure must be added about 3 million additional sleepers needed annually to repair the ravages of the war years 1936 to 1940. Since domestic production amounts to only 2 million sleepers per year, imports will be necessary. Up to the present time, small quantities were procured from Portugal, but recent restrictions upon export licenses may limit such supplies.

TABLE 5.—REQUIREMENTS OF WOOD SLEEPERS

Country	Length of railway lines	Requirements	
		Railway sleepers	Round-wood
Requirements known	*km.*	*thousands*	*1000 m³*
Germany: French zone	7,200	200	28
Austria	7,500	1,100	150
Belgium	8,000	1,500	[1]215
Denmark	3,000	455	[1]65
France	62,000	7,700	1,100
Italy	20,500	[2]3,500	500
Luxembourg	500	41	6
Norway	5,000	450	[1]65
Netherlands	5,000	[3]1,000	[1]143
Poland	35,000	3,000	[1]430
Czechoslovakia	14,900	1,700	240
Subtotal	168,600	20,646	2,942
Average per km.		*122.5*	*16.3*
Requirements unknown			
Germany:			
Bizone	36,000		
Soviet zone	15,700		
Bulgaria	3,400		
Greece	1,500		
Hungary	8,500		
Rumania	10,500		
Sweden	8,400		
Switzerland	4,300		
Yugoslavia	10,100		
Subtotal	98,400		[4]1,600
Total	267,000		4,542
United Kingdom	59,100	[5]4,000	570
GRAND TOTAL	326,100		5,112

SOURCE: Economic Commission for Europe (Transportation Committee).

[1]Average of cubic measurements changed by Secretariat.

[2]Reported figure of 6,800,000 sleepers reduced by Secretariat to figure shown.

[3]Reported figure of 1,583,000 sleepers reduced by Secretariat to figure shown.

[4]Estimated on basis of 16.3 m³ per km. of railways.

[5]Estimated using the factor of 7 sleepers per m³, the factor used by the Statistical Office.

In view of this enormous demand, what are the available timber resources in Europe?

At its first meeting, FAO's European Commission on Forestry and Forest Products made a broad review of standing timber resources and potential supplies. It noted that the hardwood sleeper requirements could possibly be supplied, but that Europe, excluding the U.S.S.R., must continue to face a deficit in softwood sleepers. Fulfillment of the import requirements of the major consumer countries will depend upon the production and domestic requirements of the producing countries of eastern Europe.

Requirements of non-European countries which purchase on the European market. The Near East countries, except Turkey, are either actual or potential importers of sleepers.

Egypt. In Egypt, there is still a large deficit in supplies of sleepers for railway lines. There have been practically no replacements during the past seven years. The immediate demand is estimated at approximately 3 to 4 million ties for maintenance and expansion of railway lines. The Egyptian Government is considering the possibility of procuring supplies in Europe, probably in Yugoslavia, as exchange difficulties are reducing purchases from North America.

Iraq. In Iraq, hardwood non-treated sleepers are used exclusively, and the Australian "jarrah" has been used to a certain extent. Up to the present, the principal supplying countries have been Turkey and Iran.

Saudi Arabia. For a long time, the demand for sleepers in this country was negligible. However, the construction of new railway lines, particularly along the edge of the Persian Gulf and in the Hejaz, has changed this situation. Saudi Arabia moved into fifth place among the customers of the United States

in 1947 when it imported approximately 300,000 sleepers.

Syria, Lebanon, and Palestine. It seems probable that these three countries will not be making any purchases on the market in the near future.

Supplies

In *Poland,* considerable efforts have been made to expand forest production. However, domestic sleeper requirements are large, amounting to 600,000 m³ (s) annually, the sleepers having an estimated useful life of ten years. Under these circumstances, Poland will apparently not be able to export to the general European market within the near future.

In *Czechoslovakia,* provision was made in the Two-Year Plan for the production of 169,000 m³ (s) of sleepers in 1947. Production realized for that year amounted to 138 percent of the goal set by the plan, i.e., 233,500 m³ (s) of sleepers. Exports were resumed during 1947 and amounted to 27,000 m³ (s).

In *Yugoslavia,* the Five-Year Plan provides for a 16 percent reduction in felling for 1951 compared with 1939. Obviously, this will result in a reduction in the over-all quantities of wood available for export purposes. However, measures have been taken to increase industrial production. The production of impregnated sleepers is to be expanded 500 percent in 1951 according to the plan. Considerable quantities may thus be available for export purposes. Moreover, this country is planning to use reinforced concrete for sleepers for its railways to a large extent. The plan also envisages the construction of 2,000 kilometers of railway lines, and this may considerably influence the export of sleepers, which has been resumed since the end of the war.

Austria has not resumed exports. This country's exports were, however, very small before the war.

Sweden is considering a reduction in felling programs; this may affect the available supplies of all products placed on the export market. However, there is no reason to predict an appreciable decrease in exports of sleepers. Swedish exports amounted to 41,000 m³ (s) in 1947 in comparison with an average export figure of 12,000 m³ (s) for the years 1934 to 1939. Swedish exports are directed primarily to Denmark, the Netherlands, Belgium, Great Britain, and Norway.

Germany, definitely an importing country with respect to sleepers before the war, temporarily became an exporter from 1946 to 1948, and its shipments, principally of softwood sleepers, were made to the western European countries.

The *United States,* despite enormous domestic requirements, exports both hardwood and softwood sleepers. In 1947 it exported approximately 6 million pieces, a great increase over shipments of preceding years, which amounted to hardly one million sleepers. The figure also exceeds the maximum exports of 1929, which amounted to approximately 5.4 million sleepers. In 1947, sleepers from the United States were shipped to 27 countries, of which 15 received large quantities. The principal countries of destination were the United Kingdom, the Netherlands, and Belgium, which received 65 percent of the total quantity. In the past, these three countries constituted only minor markets for sleepers produced in the United States.

TABLE 6.—EXPORTS OF RAILWAY SLEEPERS

Exporting country	1946	1947	Jan.-June 1948
	(..... *1000 m³ (s)*		)
Austria	—	—	—
Czechoslovakia	—	27	[illegible]
Finland	2	13	[illegible]
France	9	19	[illegible]
Germany:			
British zone	—	—	—
French zone	...	...	...
American zone	...	...	—
Russian zone	...	...	...
Norway	—	*	—
Poland	—	-	[1]
Portugal	...	...	—
Sweden	52	[2]36	12.7
Switzerland		...	...
Yugoslavia	...	...	...
Other European countries	†10	...	...
U.S.S.R.	...	...	...
Canada	113	222	188.5
U.S.A.	†63	[3]410	124.7
TOTAL	249	...	...

SOURCE: FAO/ECE, *Timber Statistics for the Years 1946-1947,* Geneva, March 1948, and *Timber Statistics, Quarterly Bulletin,* Vol. I, No. 2, Geneva, October 1948.
†Figures submitted to FAO by the governments.
*Figures too small to appear in the statistical tables.
—No exports or imports.
... Figures not available.
[1]January-March.
[2]For the first eleven months of 1947.
[3]Preliminary figures obtained from FAO estimates.

TABLE 7.—IMPORTS OF RAILWAY SLEEPERS

Importing country	1946	1947	Jan.-June 1948
	(..... *1000 m³ (s)*		.....)
Belgium	36	35	1.5
Denmark	12	9	7.0
France	21	82	22.3
Greece	*	1	0.7
Hungary	2	6	23.0
Italy	—	—	28.9
Netherlands	48	80	[1]20.9
Poland	—	—	...
Switzerland	*	1	7.7
United Kingdom	84	297	120.1
Other European countries	3	14	16.0
Egypt	†14	...	[1]3.0
Other Middle East countries	*	...	*
French North Africa	†6	...	...
TOTAL	226	...	...

SOURCE: FAO/ECE, *Timber Statistics for the Years 1946-1947,* Geneva, March 1948, and *Timber Statistics, Quarterly Bulletin,* Vol. I, No. 2, Geneva, October 1948.
†Figures submitted to FAO by the governments.
*Figures too small to appear in the statistical tables.
—No exports or imports.
... Figures not available.
[1]January-March.

United States exports started expanding in April 1947, particularly when non-treated sleepers were eliminated from the list of controlled export commodities and were placed on the list of commodities requiring only a license. Treated sleepers remained on the controlled list, and in 1947 only one million treated sleepers were exported.

In the first quarter of 1948, United States exports of treated and non-treated sleepers amounted to 23.6 million board feet—a monthly average of approximately half of that for the year 1947 (See Table 10). A considerable reduction in exports occurred in trade with the United Kingdom and the Netherlands, probably because of the shortage of exchange. Therefore,

TABLE 8.—UNITED STATES EXPORTS OF RAILWAY SLEEPERS

ANNUAL AVERAGE 1935-1939

Country of destination	Quantity			Value		
	Treated sleepers	Non-treated sleepers	Total	Treated sleepers	Non-treated sleepers	Total
	(1000 board feet)			(dollars)		
China	*	36,459	36,459	*	480,090	480,090
Canada	5,581	1,573	7,154	225,370	41,006	266,376
Guatemala	5,155	*	5,155	159,092	*	159,092
Costa Rica	3,767	2	3,769	129,229	39	129,268
Peru	107	3,535	3,642	1,942	104,146	106,088
Honduras	3,515	5	3,520	105,404	107	105,511
Cuba	2,216	15	2,231	83,377	374	83,751
Mexico	973	1,181	2,154	40,270	30,589	70,859
Panama	1,964	1	1,965	74,704	56	74,760
Venezuela	214	37	251	6,754	775	7,529
Netherlands	*	184	184	*	2,060	2,060
United Kingdom	99	37	136	1,487	552	2,039
Others	319	239	558	11,386	4,731	16,117
TOTAL	23,910	43,268	67,178	839,015	664,525	1,503,540

SOURCE: U. S. Department of Commerce, *World Trade in Commodities*, Vol. VI, Part 9, No. 4, Washington, March 1948.
*Small quantity or none.

TABLE 9.—UNITED STATES EXPORTS OF RAILWAY SLEEPERS IN 1947

Country of destination	Quantity			Value		
	Treated sleepers	Non-treated sleepers	Total	Treated sleepers	Non-treated sleepers	Total
	(1000 board feet)			(dollars)		
United Kingdom	8,387	83,294	91,681	582,716	5,773,130	6,355,846
China	7,461	24,287	31,748	644,937	1,237,950	1,882,887
Netherlands	919	20,815	21,734	91,054	1,586,386	1,677,440
Belgium	382	14,829	15,211	31,191	1,111,875	1,143,066
Saudi Arabia	466	10,057	10,523	28,914	571,312	600,226
Canada	6,339	2,870	9,209	322,832	122,922	445,754
Guatemala	3,788	7	3,795	311,292	887	312,179
Union of South Africa	1,635	120	1,755	150,204	12,042	162,246
Mexico	1,237	427	1,664	59,074	22,360	81,434
Venezuela	1,660	*	1,660	158,955	*	158,955
Cuba	1,535	*	1,535	131,465	*	131,465
Peru	*	1,371	1,371	*	113,836	113,836
Greece	823	350	1,173	41,343	32,500	73,843
Philippine Republic	1,023	*	1,023	91,599	*	91,599
Panama Canal Zone	888	*	888	67,873	*	67,873
Korea	*	725	725	*	30,500	30,500
French Morocco	384	36	420	17,410	4,410	21,820
Egypt	*	312	312	*	15,042	15,042
El Salvador	271	*	271	24,390	*	24,390
Eire	*	165	165	*	7,838	7,838
Dominican Republic	141	*	141	17,763	*	17,763
Others	280	103	383	15,972	5,500	21,472
TOTAL	37,619	159,768	197,387	[1]2,788,984	[1]10,648,490	[1]13,437,474

SOURCE: U. S. Department of Commerce, *World Trade in Commodities*, Vol. VI, Part 9, No. 4, Washington, March 1948.
*Small quantity or none.

1948 exports will probably prove to be far below the record figure for 1947.

The volume of treated sleepers which could be exported from the United States during the second quarter of 1948 was increased from 12 million board feet to 20 million board feet. Non-treated sleepers were again placed on the list of controlled exports on 23 June 1948, because of domestic demand.

Before the war, *Canada* was both an importer and exporter of sleepers. After the war, it exported large quantities of sleepers to the United Kingdom and the United States. In 1947, of 2,216,000 sleepers exported, 975,000 were sent to the United Kingdom, 808,000 to China, 139,000 to Ceylon, and 127,000 to the Union of South Africa.

Before the war, *Chile* exported large quantities of sleepers to other South American countries, and also exported to Germany. It may again offer supplies for Europe. The main species found in that country is the "roble" (*Nothofagus obliqua*).

Brazil, which has immense forest resources and which has trade relations with the European continent, is a possible source of future supplies. Central American countries, particularly Costa Rica and Nicaragua, have export supplies available.

CONCLUSION

The European market for sleepers has been comparatively quiet since the end of the war because of

TABLE 10.—UNITED STATES EXPORTS OF RAILWAY SLEEPERS JANUARY - MARCH 1948

Country of destination	Total	Non-treated sleepers	Treated sleepers
	(1000 board feet)		
Belgium	5,947	5,947	*
Egypt	4,338	1,238	3,100
United Kingdom	3,463	3,463	*
Netherlands	3,430	3,430	*
Union of South Africa	1,568	*	1,568
Venezuela	1,288	*	1,288
Canada	877	203	674
China	841	841	*
Mexico	387	181	206
Honduras	383	*	383
Guatemala	321	*	321
Others	788	342	446
TOTAL	23,631	15,645	7,986
Monthly average, 1947 (12 months)	16,449	13,314	3,135
Monthly average, 1948 (3 months)	7,877	5,215	2,662

SOURCE: U. S. Department of Commerce, *World Trade in Commodities*, Vol. VI, Part 9, No. 9, Washington, June 1948.
*Small quantity or none.

the shortage of exchange currencies and because of deferred demand.

In most countries, railways have been nationalized or placed under State control. There is therefore a monopoly in the purchase of sleepers. Where the railways still remain in private hands, consumption of sleepers is controlled by a system of issuing import licenses. On the international market, purchases of sleepers therefore depend on priorities granted in each country. Up to the present, despite the large demand for sleepers, other products have been given higher priority, and their purchase has been facilitated by the allocation of exchange currency.

Generally speaking, western European countries, and principally the United Kingdom, still have to import sleepers. Their normal market is the European market. Purchases have been resumed in Czechoslovakia and Yugoslavia, but are far from reaching the prewar volume. Yugoslavia may find it possible to increase the production of sleepers, and its exports will go principally to France. Most European countries will be obliged to purchase larger quantities on the Swedish and Finnish markets, which have increased their exports since 1946.

The quantities of sleepers available for export from European countries are smaller than in the prewar period as a result of the increase in domestic requirements of the eastern countries. Europe will therefore be obliged to look to the United States and Canada for a large part of its supplies, but purchases in these countries will be restricted by the lack of dollars and will depend to a great extent on Marshall aid. Supplies available in the United States for export purposes will be limited by domestic requirements.

Other European sources of supply are lacking as the Soviet Union is not in the export market. Therefore European countries with dependent African territories may look to them for supplies, and new sources of supply will be sought in Central and South America where there are still vast unexploited resources.

The Work of FAO

Report on the Goma Conference

THE African Conference on Soils was held at Goma (Belgian Congo) from 7 to 16 November 1948.

Mr. Show and Mr. Terver of the Division of Forestry and Forest Products represented FAO at this meeting.

Present at the conference were delegations from Portugal (Mozambique and Angola), Southern Rhodesia, the French Union (French West Africa, French Equatorial Africa, the Cameroons, and Madagascar), the United Kingdom and the British colonies (British East Africa, British West Africa, and Northern Rhodesia), the Union of South Africa, Belgium (Belgian Congo and Ruanda Urundi), and many observers.

Organization of the Conference

The conference immediately divided into five sections with the following agenda:

1. *General and regional study of soils.* (a) Analysis and survey methods; general properties and classification. (b) Properties, regional classification and mapping. (c) Pedogenesis factors; ecology and effect of the vegetative cover. (d) Land use.

2. *Causes and aims of soils degradation.* (a) General aspects and regional situations. (b) Vegetative cover destruction and some causes of degradation.

3. *Cultural systems in relation to soil conservation.* (a) Anti erosion techniques. (b) Cultural methods. (c) Fallows and cover crops. (d) Pastoral and agrologic problems. (e) Brush fires in general and in their relations with animal husbandry.

4. *Development of agricultural mechanization and manuring.* (a) Agricultural mechanization. (b) Manuring.

5. *Social and economic problems in relation to soil conservation.* (a) Rational organization of agriculture. (b) Population regrouping and deplacing. (c) Forestry problems in relation to native economy. (d) Agricultural propaganda and education. (e) Miscellaneous.

The conference afforded a very valuable medium for the exchange of technical information.

More than 150 specialists were present, most of them highly qualified and having wide experience in the fields of pedology, agriculture, animal husbandry, forestry, and soil conservation and improvement in general.

Forestry

The following points were the principal conclusions of the conference with respect to forestry.

The deterioration of African soils is above all due to bad agricultural practices (uncontrolled roving agriculture) and bad grazing usages (overgrazing, careless spread of free-running fires). These abuses lead to a rapid disappearance of the vegetative cover, with all its consequences.

If, for social and economic reasons, it is absolutely necessary to make intensive use of the soil, proper regard must be given to land conservation. To put into effect a rational policy of soil use, governments must, amongst other things, adopt a clear-cut forest policy, including the reservation of a forest domain of an extent appropriate to the local conditions. Not only protection forests but commercial forests also should be classed as part of the essential vegetation cover.

Improvement of the growing stock in commercial forests, brought under regular methods of management, should be developed through the system of planting trees with native crops. This can be done by setting aside areas for temporary cultivation by villagers, without impairing the status of the forest. The method has been used in British territories over a long period and has yielded excellent results.

At the instance of the chief of the French delegation, the principle of the maintenance of the forest cover proper was extended to apply also to those areas where the high forest borders on the savannah lands, and where the protection of forests, already partially destroyed, is absolutely necessary.

There was unanimous condemnation of the practice of causing bush fires and free-running fires. The ultimate aim should be to suppress them altogether. However, recognizing that these fires are sometimes inevitable owing to the primitive nature of agricultural methods in Africa and especially of animal husbandry, the majority of delegates agreed that the practice must for the time being be tolerated, but it should be strictly controlled. Wherever possible, over limited areas, fire-fighting must be undertaken. Elsewhere, preventative measures such as backfiring should be attempted.

Agriculture

From the agriculture standpoint, the attention of delegates was drawn to the importance of mechanized methods of cultivation, properly conducted to permit both extensive agriculture and proper soil conservation. Delegates had reservations regarding the use of chemical fertilizers and wanted further experiments carried out. However, they strongly endorsed the use of organic fertilizers for restoring certain ingredients to the soil.

The rapid growth of native populations in certain limited regions, and the special problems which arise around large centers of population were also discussed by the Conference. For these regions, delegates requested comprehensive control measures against rapid soil deterioration, and the provision of staff, equipment, and funds to carry them out.

As regards livestock management, attention was particularly drawn to the dangers of overstocking range lands, the result amongst other things of certain native prejudices, which regard flocks and herds as manifestations of real wealth.

Certain Recommendations

Although FAO's delegates were unable to attend the last meetings and the final plenary session, the following is the substance of three of the more important recommendations, as drawn up by the drafting committee.

1. An African Information Bureau on Soil Conservation and Use (Bureau inter-africain d'information sur la conservation et l'utilisation du sol) to be established in Paris, where all information bearing on technical, economic, or social aspects of soil conservation could be collected and collated with existing knowledge, and the findings of institutes specializing in this field.

The bureau would also establish contact with local organizations and the regional committees referred to below, and provide a focal point for communication between these bodies.

A meeting of experts should be held in the near future to decide the exact organization and function of this bureau.

2. A research center to be established for promoting methods of soil analysis best suited to African conditions, and for determining uniform procedures for the study, classification, recognition and mapping of soils. This center would also be charged with arriving at a generally accepted system of terminology and nomenclature.

This African Soils Service (Service pédologique inter-africain) could be administered by the Institut national pour l'Etude agronomique du Corps belge, and be located at Yangambi. It should be properly equipped to carry out its tasks and be provided with funds adequate to permit its members to travel throughout the African territories, and conduct local enquiries and interchange of experience.

3. To supplement the above, it would be necessary to set up permanent Regional Committees on soil conservation and utilization in the different African regions. These committees should be made up of technical representatives from each territory falling within the area concerned, and they should meet together at least once a year. Their principal task would be to determine how the agreed objectives could best be achieved under existing local conditions and to propose common plans of action.

The division into geographic regions should be decided by a meeting of experts to be called as soon as possible. There should be at least three regions: central, east, and west.

News of the World

The items appearing here are condensed selections of news thought to be of interest to readers of UNASYLVA. *They are grouped alphabetically by countries under headings currently used by the Division of Forestry and Forest Products for reference purposes. The Editor will be glad to receive direct from readers authenticated items of interest and news value for this part of the review.*

General

CZECHOSLOVAKIA

• There are four forest schools of the higher college grade with four years of instruction. The entrance requirements are the same as for any other institution of higher learning, with the addition of at least one year of preliminary practical training in the woods under the supervision of the forest school authorities. There are nine schools of the lower or vocational grade for training forest guards and other forest personnel for the practical work in the forests. The course takes one year and the entrants must be at least 18 years old and have some forestry experience.

GERMANY

• Bavaria has 2.25 million hectares of forest land constituting approximately one third of the total forest area of the country. Standing timber volume is estimated at 180 million cubic meters, of which 82.3 million cubic meters is in State forests, 24.2 million cubic meters on lands owned by communities, 48.5 million cubic meters in privately-owned forests more than 10 hectares in size, and finally 25 million cubic meters in privately-owned forests less than 10 hectares in size. The annual increment is approximately 6½ million cubic meters. Fellings amounted to: 8 million cubic meters in 1945; 11.9 million cubic meters in 1946; and 11.2 million cubic meters in 1947. In 1946, timber, excluding fuelwood totaled 5.6 million cubic meters and, in 1947, 5.2 million cubic meters; 93 percent of this timber consisted of softwoods and 7 percent of hardwoods. During the war, due to the lack of proper care, the *Bostrychidae* invasion assumed catastrophic proportions, making it necessary to fell 2 million cubic meters of spruce. There is a huge demand for wood due to the housing shortage. It is estimated that between 600,000 and 700,000 cubic meters of lumber are required to relieve the shortage. This quantity has been calculated on the basis of families lacking housing facilities.

UNION OF SOVIET SOCIALIST REPUBLICS

• There are at present 12 forest institutes devoted exclusively to the training of specialists in all branches of forest management and forest utilization. In addition, there are 11 universities and agricultural schools which have departments of forestry. Within recent years, much emphasis has been laid on training specialists in forest engineering and for the various branches of the timber industry. Several thousands of such specialists have now been absorbed in the timber industry. In addition to the regular forest schools, there are 15 special forest research institutions and a great number of experiment stations and laboratories in all parts of the country.

Silviculture and Management

AUSTRIA

• Inventories carried out in unexploitable parts of the Hollengebirge forests, 40 kilometers east of Salzburg, give a very accurate picture of the conditions of the forests of the whole region prior to man's interference.

At altitudes varying from 500 to 1,000 meters, beech and silver fir, with some Norway spruce, are the main species. (Elsewhere this tree association has been replaced by pure planted stands of Norway spruce.)

Other species which occur here but have completely disappeared elsewhere are yew, ash, maple, elm, linden, and, up to 800 meters, oak.

The soil of the forests is in excellent physical, chemical, and biological condition; natural regeneration is strong and abundant. Elsewhere the soil has deteriorated and is covered with a layer of acid humus.

To rehabilitate the country's forests, it would be advisable to reintroduce fir, protect whenever possible the scanty beech regeneration and discontinue the planting of Norway spruce. This should not be difficult since many stands of this species, severely damaged by bostrychids and the nun moth, have had to be felled and removed.

FRANCE

• The French Academy of Agriculture recently discussed the results of experiments conducted by a society for the study of the uses of *Musanga* on the Ivory Coast. *Musanga smithii*, a species which invades cleared areas in the African rain-forest zone after fellings, is apparently of great value in establishing second-growth stands of rapid growth which can supply good quality pulp. Recent experiments dealt particularly with methods of stimulating germination of the seeds which normally are scattered by animals and do not, as a rule, germinate unless they have passed through their digestive systems. Experiments were conducted in soaking the seeds in solutions of sulphuric and hydrochloric acids of varying concentrations for different periods and with occasional rinsings. Nevertheless, doubts have arisen as to the future of artificially established stands of *Musanga*. It is possible that this type of forest should only be considered as a transitional one, the permanent culture of which would entail soil degradation. On the other hand, the possibility of utilizing this type of forest to obtain raw material for the manufacture of pulp requires further study before large-scale operations can be envisaged.

NETHERLANDS

• Out of a total area of 3,480,000 hectares, forests cover only 257,675 hectares or 7.4 percent of the total. During the war, in order to meet the need for fuel, 30,000 hectares were felled. However, by the end of 1947 approximately 10,000 hectares had been reforested and trees bordering roadways and avenues had been replanted. Trees planted along the roads cover an area equivalent to 30,000 hectares or approximately 12 percent of the wooded area and supply a considerable portion of the timber requirements of the country.

UNITED STATES OF AMERICA

• The possibility of harvesting pulpwood down to smaller limits was studied recently in Minnesota. Although tests were made under rather special conditions, in fairly dense stands of black spruce, *Picea mariana*, the results were encouraging. In cutting down to a diameter of 7.6 cm. (3 in.) instead of 10 cm. (4 in.), a 21 percent increase in yield was obtained, while lowering the limit to 6.4 cm. (2.5 in.) produced an additional 6 percent. Logging costs were not substantially increased, being $17.04 per 2.8 m^3 (100 cu. ft.) for the 6.4 cm. (2.5

in.) limit against $16.77 for a 10 cm. (4 in.) limit. As total expenses were spread over a greater volume of yield, over-all costs per unit of volume were actually reduced. With increased mechanization, logging costs should also be reduced. The results of this study should not be interpreted as justifying the cutting of immature stands. It should, however, encourage better silvicultural practice since, for one thing, the harvesting of material down to 6.4 cm. (2.5 in.) should considerably reduce waste left in the forest

Mensuration, Increment, and Yield

CANADA

• The Dominion Forest Service recently took into use several increment hammers which are designed to replace the conventional increment borer for certain types of work where only the current growth is required. The major advantage of the instrument for such work is the rapidity and ease with which it can be used. Only a few seconds are required to extract a core ½ to ¾ inch in length which will show the current growth. Disadvantages are that the age of trees cannot be determined and also that cores extracted may not be suitable for accurate measurement since considerable skill is required to obtain a core along a true radius of the tree. Used like a hammer, the cutting bit of the instrument is driven into the tree by the impact of the weighted head. The core is extruded through the nose of the bit by pushing on the extractor after the instrument is pulled out of the tree. The hammer may be used on frozen wood, and on thick-barked trees; in the latter instance it is desirable to strike the tree in one of the furrows of the bark. The borer, which weighs 13 ounces, is 10 inches long and is obtainable in two models differing only in the form of the handle. The model described, with the handle-grip of wood and steel, is preferred by the Forest Service.

Forest Protection

EUROPE

• The spread of bostrychids in Europe since the war has reached serious proportions in some regions. Damage seems to be particularly severe in the Soviet zone of occupation in Germany, where it is estimated to have amounted to 2 million m^3 in 1947, as compared with 700,000 m^3 in 1946. The forests of Thuringia, the Harz Mountains, and the Erzgebirge have been particularly affected. The Economic Commission of the Russian zone has issued a decree appointing a special authority to co-ordinate the fight against this pest and providing for the application of extremely strict measures. In order to avoid bottlenecks in the transportation of the felled timber, they are considering shifting sawmills and installing new mills close to affected areas, recruiting the additional manpower necessary by drawing upon less important industries. In France, the invasion, after having ravaged the Vosges, is spreading to the southeastern part of the country, to the Bugey, Savoy, and Dauphiné forests.

Logging and Engineering

UNION OF SOVIET SOCIALIST REPUBLICS

• A new universal tractor has been developed which is especially adapted for hauling purposes. It is very small, mounted on a light frame with two wheels and has a 3 h.p., one-cylinder motor. The operator walks behind the tractor and holds its two handles like a plow. This tractor can be used for agricultural as well as for forestry purposes. It moves at a rate of 2.5 to 4.5 km. per hour. The consumption of gasoline, for a field of one hectare, is about 1.5 liters. This baby tractor can also be used to pull a cart with a load of 500 to 700 kg. With a load of 700 kg., it can attain a speed of 8 to 9 km. per hour.

• In machine sanding, pressure is the chief factor affecting rate of production. In common practice the operator judges the degree of power largely by ear. This practice is not always satisfactory. Experiments conducted with sanding machines indicate that sanding pressure and power consumption are directly proportional; the desired pressure, therefore, can be determined and controlled by readings from a wattmeter in the motor circuit. It was further found that the grain of the abrasive and the species of timber, all other conditions being the same, have little effect on power consumption. With drum sanders, width of the articles processed has a significant effect. For a given machine, it is possible to compile a table from which the operator can read the appropriate power consumption for articles of various widths.

Conversion

UNITED KINGDOM

• A new improved synthetic board of special value to the building, furniture, and veneering industries is announced by British Plimber Ltd. The company has been marketing Plimberwood during the past two years and well over 5 million sq. ft. of that material have been employed in a wide variety of industries. For some time the firm has been carrying out research into the behavior and production methods of wood-waste boards generally, with a view to marketing a product which would overcome deficiencies common to the majority of wood-waste boards.

The new board, Plimberite, is described as a harder, denser board than Plimberwood. It is not, however, so hard as to be detrimental to cutting tools. It has a smoother face and closer texture and is considerably less absorbent; it is easier and more economical to decorate and can be cut and machined more cleanly. The makers state that Plimberite overcomes unevenness, one of the main disadvantages of Plimberwood, and its accuracy of thickness is claimed to be comparable to high-grade plywood. At present, Plimberite is available only in 1.6 cm. (⅝ in.) thickness, but plans are proceeding for the production of a 1.27 cm. (½ in.) thick board to be followed possibly by other thicknesses.

UNITED STATES OF AMERICA

• In the opinion of the Technical Director of the Northeastern Wood Utilization Council, a number of commercial processes used in Europe could be translated into economic enterprises in the northeastern United States. Some of these processes are: (1) A process for the simultaneous production of tannin and furfural from oak. Successful plants for these chemicals have been operating for a decade. (2) A simple semichemical pulping process, working on hardwoods and agricultural wastes. Plants making about 30 tons of pulp daily have been operating for 5 years with success. The process consists of mild cooking with sulphuric acid, followed by a simple refining with little power usage. Furfural is obtained as a by-product to the extent of 4 percent of the dry wood substance cooked and sold to plastics manufacturers. (3) A "dry" wallboard process for which several plants have been installed recently making a commercial product of high quality from sawdust and shavings. (4) A "wet" wallboard process which includes a mild pulping and makes a hardboard of exceptional strength. (5) Plants for the continuous distillation of both softwoods and hardwoods which are flourishing in Europe.

• The search for a way to make sawdust-resin board was begun by the Monsanto Chemical Company in order to find a material for hollow-built kitchen cabinet doors. Unsolved questions as to proper sawdust particle size, moisture content, and type of resin bonding, together with mechanical problems of equipment, heat and pressure cycles, uniform feed and worrisome warping combined to give research men many a nostalgic memory of once-inexhaustible forests and plentiful prewar lumber supplies. More than four hundred test panels were made, dozens of resins tried. Finally the combination — 93 percent finely divided wood, Monsanto's Resinox (a phenol formaldehyde plastic) and other ingredients—emerged as the choice.

In production, a sizable portion of this conglomerate waste now is sucked in pipes to the plant where it is ground to still smaller size by the punishing action of a hammer mill. After a thorough mixing with the bonding agent, Resinox, the yellow sawdust mix is next fed by a specially built machine into square trays, four feet on one side. From the feeders, the trays are slipped into a hot press similar to that in common use in plywood making. The mixture is compressed under heat and high pressure to one-quarter inch thickness. The result is Prespine, a panel made almost entirely from sawdust, finely divided wood rejected for its knots or other imperfections; trimmings; all materials which have little other use than firing a mill's boilers.

Before the production phase of the project had been entirely completed, the motive behind the development had altered. Progressively worsening supplies of plywood for panels used in millwork of all kinds had shrunk to alarming levels. For that reason, Prespine was used

immediately for panels of doors, garage doors, and parts of kitchen cabinets. When present plans for enlarged production are accomplished, Prespine's employment may cover a still broader field.

UNION OF SOVIET SOCIALIST REPUBLICS

• The increased demand for pulpwood under the present five-year plan makes it expedient to use material from north and northeastern conifers grown on poor soils, including topwood, which before was used only for firewood. Such wood is very fine-grained; there may be 12 to 18 rings to the millimeter in the outermost wood in trees 180 to 220 years old. Parallel sulphate cookings of the narrow-ringed and wide-ringed wood showed no significant differences in cellulose yield per unit weight between the two kinds of wood. They may therefore be cooked together under identical conditions. As a matter of fact, the narrow-ringed wood, because of its higher specific gravity, may produce a higher yield. The presence of twisted fiber and eccentric growth often found in this kind of wood does not prevent its use in manufacturing high-grade pulp. It has a somewhat higher resin content but, at the same time, it contains considerable quantities of humic or lignin-like substances which do not impair pulp quality. Its chief disadvantage is its knottiness. This often limits its use to the sulphate process or to the production of papers of only average quality.

Utilization

UNION OF SOVIET SOCIALIST REPUBLICS

• More than 60 plants are turning out prefabricated houses today in the Soviet Union. This industry is relatively new but developing rapidly. The pressure for the construction of new dwellings is enormous. About one-third of the dwelling areas of Soviet cities were destroyed during the war. Rapid erection of houses for the people who lost their homes during the war, as well as for the new towns and cities springing up around industrial centers, is an urgent necessity. Prefabricated houses seem to be the answer to the problem. This is especially true for the new mining centers where, as in Donbas, no timber is available nearby.

The Ministry of Building Materials is in general charge of the work. In 1948 almost three times as many prefabricated houses as before the war are said to have been produced. The vast forests of the north provide most of the raw material for building the houses. The plants manufacture all the structural material for the houses, including insulation and facing materials, and some of them produce as many as 7,000 houses a year per plant.

While standardization is essential to mass production of prefabricated houses, variety in the designs is not overlooked. There are more than 100 types of houses to suit various locations. No two plants turn out the same type of house. No plant can begin production of a new type of prefabricated house unless it has been approved first by a Committee on Architecture consisting of members of the Academy of Architecture and other prominent architects. A prefabricated house usually consists of two or three rooms, plus kitchen, bath, closets, and other conveniences.

The local Soviet furnishes the plot and municipal services. State credits are provided to the home builders. Loans are repayable in ten years and the monthly installment is usually no more than the regular rent would be for similar accommodations in an apartment house.

• The Technical Forest Institute of Archangelsk has developed a method of making a new type of charcoal-pitch briquets. This consists of (1) reducing the charcoal (hardwood or coniferous) to particles of 0.1 to 1.0 mm. in size; (2) adding water (4 parts) to dry pitch (6 parts); (3) heating the two to about 50° C.; and (4) mixing first to a uniform emulsion and then with the charcoal (10 parts). The resulting mass is allowed to stand for 48 hours, pressed to the desired shape, and baked in closed retorts for about 12 hours and to a final temperature of 400° to 500° C. to remove water and volatile constituents. Underbaked briquets will smoke; the overbaked are smokeless but hard to ignite. The yield of briquets is 40 percent to 55 percent of the wet mixture. Their average calorific value is said to be 7.130 to 7.284 calories per kg.

New Methods

CANADA

• A newly-formed company hopes to manufacture cigarette paper from pulp of fruit tree trimmings in a proposed 10-ton-a-day Ontario pulp plant. Investigations into the possibility of making pulp from fruit tree trimmings began in Toronto in 1936. Two years later the Pulp and Paper Research Laboratory in Montreal investigated the possibilities and manufactured about 640 kg. (1,400 lbs.) of pulp. The process is stated to have been patented in several countries by the Pangara Holding Corporation. Shaw-Manson Ltd. will operate under an exclusive license from this corporation for Canada, United States, Great Britain, and France. Pulp from fruit tree trimming is said to be possible at a cost of $220 a short ton f.o.b. mill, including allowances for royalty, wages and all materials, but not allowing for taxes or depreciation.

UNITED STATES OF AMERICA

• In July 1948, at New Haven, the Northeastern Wood Utilization Council brought together representatives of New England Agriculture Experiment Stations for a discussion of chipped wood as a method of adding organic matter for the improvement of soil structure. Definite tests are planned by the stations in Connecticut, Rhode Island, and New Hampshire. It was decided that the use of wood chips at the rate of 56 metric tons per hectare (25 short tons per acre) would make this method roughly equivalent in organic matter to the standard 45 metric tons of manure per hectare (20 short tons per acre) allowing for the difference in moisture content and assuming that disintegration of the wood material would be spread over three years. In southern New England, because of the scarcity of cattle bedding, wood chips may possibly be largely diverted to that use and reach the soil as part of the application of farm manure. It is important, however, to learn what wood chips as such would do to the soil.

Economics and Statistics

ALGERIA

• In 1948, Algerian forests supplied 220,000 metric tons of fuelwood, 400,000 quintals of charcoal, and 150,000 m^3 of timber against only 90,000 in 1938. Lumber imports rose to 165,000 m^3. The cork yield amounted to 333,000 quintals. The Forest Service has started a series of experimental areas where suitable conditions can be created for securing natural regeneration and at the same time satisfy grazing requirements. The Service is also concentrating attention on soil conservation and improvement. Through the use of new equipment and methods, orchards can now safely be formed on hill slopes.

CANADA

• Plans for a new pulp and paper mill to be built at Lepreau, New Brunswick, Canada, are nearing completion. The proposed mill will have an estimated daily capacity of 500 tons of kraft pulp and 500 tons of newsprint. Consumption of pulpwood will amount to 1 million m^3 (r) (400,000 cords) a year. It is reported that actual construction is planned for November, 1948. The mill is to be completed and in production early in 1950.

CHINA

• The Taiwan Pulp and Paper Corporation, controlled by the National Resources Commission of China, has two plants designed to make pulp from bagasse or bamboo. The larger, located near Lotung, and three miles from large sugar installations, has a daily production capacity of 100 tons but at present is producing only 15 tons. No paper is produced and the pulp, for the most part, is shipped to the mainland and used in production of Chinese paper. The smaller plant, near Taiwan, varies only in size and is designed to produce 50 tons per day. It is using bamboo as raw material for pulp production.

IRAN

• The foundation stone of the first paper mill to be built in Iran was ceremoniously laid at Veramine, a town near Teheran chosen as a key center for industrial development. The Iranian Paper Mill Co. Ltd. is planning the new factory to produce 4,000 to 4,500 tons of writings and wrappings yearly. This represents the total amount of these two classes of paper which the country is at present importing. Samples of raw materials and the water to be used have been submitted to experts in Europe for analysis and are said to be highly satisfactory. The new factory is being built of steel and reinforced concrete and will cover an area of 8,000 m^2. The principal raw materials to be used will be straw, cotton waste, and other waste products which are in abundant supply. A chemical plant for the production of the necessary chemicals is to be included in the new buildings.

KOREA

• The largest and only modern paper mill in South Korea was shut down during June 1948 for the second consecutive month because of lack of pulp. Production continued, however, in 14 other mills. Although total production in June was the second lowest in any month during the first half of 1948 and 28.6 percent below the monthly average for 1947, it was about 12 percent higher than in May 1948. Monthly average production, in metric tons, was 324 in 1946, 266 in 1947, and 162 during the first half of 1948.

NORWAY

• According to the Director of the Norwegian Cellulose Association, production of the Norwegian pulp industry in 1948 was about 60 percent of capacity. The reason for the low level of production was the shortage of raw materials. Total fellings were almost equal to the cut before the war but a considerably larger proportion than previously was destined for the sawmill industry for building reconstruction. The distribution of roundwood continued to be controlled by Governmental authorities. Production of cellulose during 1948 was about 380,000 tons. About 60 percent of the production was manufactured in Norway into paper, pasteboard, cartons, rayon and cellulose wadding, etc., and only 40 percent exported. The deliveries of inexpensive types of cellulose to the domestic paper industry at prices fixed by the Price Commission considerably below export prices, as well as below production costs, caused extensive loss to the cellulose industry. The export prices for cellulose during 1948 were satisfactory; but the top prices previously quoted on certain markets were unattainable, and even the prices on the main markets decreased.

SWEDEN

• Certain regulations governing the paper trade since April 1947 were abolished in January 1949. Thus, rationing and similar restrictions of deliveries of paper and paperboard on the interior market are cancelled but, on the other hand, the price stop will still be in force. For newsprint, however, special agreements have been made between the Fuel Commission, the publishers and the newsprint mills to reserve similar quantities of paper for the Swedish newspapers in 1949. In view of the changed situation on the export market, the pulp industry has declined to renew the agreement in respect of deliveries of pulp to the paper industry at reduced prices as the export sales do not reasonably compensate for the losses on the home market. In 1948 these deliveries were to comprise 90,000 tons of chemical pulp and 14,500 tons of mechanical pulp, dry weight. It seems likely that increased sales of pulp and paper will be directed towards exports and that the shipments to the home market will be cut down.

UNITED STATES OF AMERICA

• Latest statistics reveal that the amount of paper consumed in one year by the average American is about 154 kg. (340 lbs.), an increase of 130 kg. (286 lbs.) per person during the past 50 years. About 30 kg. (66 lbs.) of this total represents newspapers; 70 kg. (156 lbs.) are used in paperboard containers, boxes, wrapping paper, and paper bags; while books, letter paper, railroad tickets, milk and food containers, telephone directories, catalogues, tissues, paper rugs and curtains, and automobile upholstery covers make up the balance.

UNION OF SOVIET SOCIALIST REPUBLICS

• The Angara-Lena region of Eastern Siberia may become in the near future an important center for forest industries. It has been recently estimated that within this region there is a forest area of almost 6 million hectares, with a stand of 31 million m^3 (r) of merchantable timber. This would permit an annual cut of from 400,000 to 425,000 m^3 (r). More than half of the timber is mature or overmature. The species, in order of their abundance, are Scots pine, *Pinus sylvestris;* the several kinds of larch, spruce, birch, aspen, and Siberian pine, *Pinus cembra.* Further and more exact aerial and ground surveys are needed, as well as more detailed planning as to the most suitable location of the industries with reference to transportation and communication.

• According to the postwar five-year plan, the lumber industry in 1950 is to produce 39 million m^3 of sawn lumber, furnish the railroads with 185 million ties, and increase the production of veneer and other lumber products. Since the new sawmills to be erected during the five years of the plan will be capable of producing 6 million m^3 of sawn lumber, the increase in production must be absorbed by the already existing sawmills even though the present productivity of the sawmills for the country as a whole is said to be below the prewar level.

Policy, Legislation, and Administration

ITALY

• As a step towards the "customs Union" between Italy and France, a commercial agreement became effective on 1 April 1948. This agreement provides among other things for the export to France of poplar cuttings, tree seeds, tanning extract, special paper, and minor forest products. Exchange of forest products between the two countries is expected to increase considerably. Italy could export fine paper, cellulose, tanning extract, and manufactured articles in walnut, oak, and cherry. France could export okoumé from Africa, softwoods, hardwoods, and walnut and oak veneers. The export of surplus tanning extract from Italy is important since France still depends on quebracho from Argentina.

UNITED STATES OF AMERICA

• Surveys of the timber resources on 25 million ha. (63 million acres) of forest land in 12 states and the re-inventory of an additional 19 million ha. (48 million acres) in eight other states have been completed within the past two years. This brings to 148 million ha. (365 million acres) the total so inventoried since the project to survey the United States timber resources was begun in 1930, while 105 million ha. (259 million acres) are still to be covered. Provision for periodic re-inventory of the timber resource on land already surveyed was made by Congress in 1944 in order to keep the reports up to date. Up to now 19 million ha. (48 million acres) have been gone over for the second time. Cutting operations, forest fires, attacks of insects and disease, and changes due to growth are principal factors in making it necessary to recheck these areas if the survey figures are to be kept up to date. The surveys were made for areas where reliable information as to forest areas, timber volumes rates of growth and depletion, ownership, and demand for forest products are vitally needed as a guide to sound programs for industrial development, taxation, fire prevention, and land management.

Meetings

FIRST MEETING OF THE SUBCOMMISSION ON MEDITERRANEAN PROBLEMS

A subsidiary body of the European Forestry and Forest Products Commission, the Subcommission on Mediterranean Problems, held its first meeting in Rome from 13 to 17 December 1948 in the Villa Borghese, the temporary headquarters of the FAO European office.

Greece, Italy, France, and the United Kingdom sent delegations. Yugoslavia and the State of Israel were represented by observers. The meeting was organized by the Italian National FAO Committee, and His Excellency Antonio Segni, Italian Ministry of Agriculture, opened the session. Professor Aldo Pavari, of the University of Florence, was elected Chairman and Mr. Challot, Conservator of Forests and Waters in French Morocco, was elected Vice-Chairman. Professor Guinier, Chairman of the Academy of Agriculture of France, one of the leading organizers of the prewar "Silva Mediterranea," was elected Honorary President.

The Subcommission decided on the countries to be included in its studies and approved a report containing a number of recommendations covering its future activities. Special attention was paid to problems of soil utilization and conservation, control of grazing, and reforestation. This report will appear in the next issue of *Unasylva.*

CONGRESS OF THE NORWEGIAN UNION OF FORESTRY AND LANDWORKERS

Two hundred delegates attended a Congress held by the Norwegian Union of Forest and Land Workers 3-7 October 1948. The Chairman of the Union called attention to the progress made in the establishment of a 48-hour week for forest and land workers. The following items were discussed by the delegates: Organization of training for forest workers, housing conditions in the forest, eventual expropriation of poorly managed forests, trade problems, and the economic situation in Norway.

Reviews

Erosion, Cancer del Suelo. Victor Bianchi Gundian. Imprinta Universitaria, Santiago, Chile.

This pamphlet published by the Forestry Department of the Ministry of Lands and Colonization of Chile is intended for mass distribution and presents in a striking manner a series of carefully checked data and conclusions arrived at from studies of the damage caused by erosion in Chile, Switzerland, Sweden, Canada, Mexico, the United States, and Peru.

The importance of this question for Chile can be realized from the fact that out of 19 million hectares of land under cultivation, at least 4 million have already suffered more or less seriously from the effects of erosion. The production capacity of the province of Malleco, the granary of Chile, was reduced in 30 years by 32 percent, through the loss in fertility of the topsoil.

The booklet contains a number of graphs designed to attract attention and arouse interest; it concludes with 12 recommendations which could well be called the Twelve Commandments of soil conservation. The first of these declares that land with a slope of more than 18 degrees must in all cases remain under forest.

The Redwood Forest Handbook. Jack Reveal and Arnold Wallen. Division of Forestry, California Department of Natural Resources.

This compactly written pocket-sized handbook should be of great value to foresters, woodsworkers, operators, and timberland owners of the redwood region. It is a compilation from many sources of information needed in the redwood region.

After a brief description of the trees and the forest, it covers methods and results of partial cutting in both old and young growth forests, and discusses the forest protection problems of the region, especially the problem of disposal methods for the enormous quantities of slash left by logging.

A useful section on cruising timber gives field methods for sampling, intensity of sampling for different standards of accuracy, volume tables, and allowance for defect. The information on log scaling includes method and equipment, the log ruler, and deductions for defect.

An appendix gives a glossary of lumber terms and information on tractor production and cost estimation.

Cours élémentaire de sylviculture (Elementary Course in Silviculture). Bradfer and Turlot. Pp. 428, no price given. Ad. Wesmael-Charlier (S.A.), Namur, Belgium.

This book was first published in 1932 and has now been brought up to date in a second edition. It is intended primarily for the training of Belgian forest rangers and presents the subject matter in the form of a series of questions and answers.

Economie forestière (The Forest Economy). F. Frankhauser. Pp. 388, 11 Swiss francs. La Librairie Payot, Lausanne, Switzerland.

This is a fourth French edition of the book based on the 7th German edition. It is a practical guide written in simple language without unduly heavy scientific language, and is intended primarily for use by forest owners. It emphasizes wise principles of management, the practice of which has succeeded in making Swiss forests among the richest and most productive of Europe. The author points out the importance of preserving indigenous acclimatized strains and the advantages of the natural regrowth of forest stands with the natural mixed forest as a goal.

The Anthracite Forest Region, a Problem Area. Frank A. Ineson and Miles J. Ferree. Northeastern Forest Experiment Station, Forest Service, United States Department of Agriculture. Miscellaneous Publication No. 648.

This study is of particular interest because it explores the reciprocal relations between forests and coal mining, and examines the possibilities for improving forests and thereby making them provide greater employment and greater industrial output. The anthracite forest region of northeastern Pennsylvania is a problem area. During the 1930's unemployment in this region was especially severe. In 1938, when the relief load was at its peak, 364,000 persons—nearly a quarter of the total population—were dependent on public-works programs and direct relief. In that same year the figure for the rest of Pennsylvania was 16 percent.

This situation, though aggravated by the general depression, was due largely to specific local conditions. During the preceding twenty years the production of anthracite coal—the most important source of employment in the region—had fallen off 50 million tons, or 50 percent. Furthermore, a reduction in markets and in the amount of recoverable coal make any considerable increase in production improbable. During the war, unemployment in the region temporarily disappeared. But the basic situation still exists, and only a major readjustment of the region's economy can prevent serious unemployment in the future.

Next to coal, the most important natural resource is the forest. Of the 5.25 million acres that comprise the region, 3.25 million are forested. Though in poor condition now, these forests were once among the finest in the United States, and their potentialities are still great. By energetic forestry programs, sawtimber growth could be increased at least twelve times, and employment and industrial output be increased more than fourfold.

A successful program would extend public ownership, set minimum standards for private management, and expand cooperative work in various directions. Here is a case where an extended forestry program can measurably solve the problem of a region where economy is declining as a nonrenewable resource decreases.

Insect Borers of Newly Felled Timber and Their Control. Indian Forest Bulletin No. 136. Forest Research Institute, Dehra Dun, India.

An account is given of an investigation into the prevention of insect damage to the newly felled timber of *Vateria indica*, *Dipterocarpus indicus*, *Terminalia belerica* and *coffeoides*. The experiments were designed to explore the possibilities of preventing damage by relatively simple adjustments of management rather than by use of chemical repellents. The insects found attacking the timber were chiefly of the *Cerambycidae*, *Buprestidae*, *Platypodidae*, *Scolytidae* and *Bostrychidae* families. Their seasonal incidence, conditions of attack, extent of damage, and the methods indicated for their control are discussed for each species of timber. The technique employed in the experiments is described.

Fontes Historiae Botanicae Rossicae. Vladimir C. Asmous, B.A. Chronica Botanica, Volume II, number 2. The Chronica Botanica Co., Waltham, Massachusetts, U.S.A.

In this study an endeavor has been made to enumerate all publications which deal with the history of botany in Russia. The list includes technical and historical publications and such biographical and bibliographical works as seem likely to be useful to the student of the subject.

This article should prove a valuable guide to all botanists interested in the development of botany in eastern Europe and northern Asia.

The German Forest Resources Survey. Special Report of the Military Governor. No. 40. Pp. 48. Office of Military Government for Germany (U. S.), 1 October 1948.

This Report on the German Forest Resources Survey, issued by the Office of Military Government for Germany (U. S.) in October 1948, is based on a survey of the forests of postwar Germany conducted in 1946 by German foresters under the general direction of forestry officials of the four occupying powers.

The statistics were collected in German units of measurement, volumes being recorded in festmeters. The festmeter is defined as a cubic meter of tree trunk material, but in forest management three different kinds of festmeters are recognized:

(1) The volume festmeter with bark gives the volume of the entire stem of the tree, from the ground to the top, including the bark.

(2) The harvest festmeter with bark gives the volume with bark from the stump to the point at which the diameter of the tree is 7 cm. This measurement is 10 percent less than the volume festmeter, because of logging loss.

(3) The harvest festmeter without bark is the same as (2) except for the bark. Roughly 10 percent of the volume is lost with the bark, although the percentage varies between 9 and 13 depending on the species of timber.

For small material which is cut into short lengths and stacked the Germans use the raummeter, which is one cubic meter of piled wood. Because of air spaces between the pieces, a raummeter corresponds to 0.7 festmeter. For lumber and other sawn material the cubic meter is the standard of measurement.

The survey covered all forests except those which are less than 10 hectares in area. Most of these small forests are attached to farms, and average volume per hectare and annual growth are much less than in the larger forests. It is estimated that the rate of growth on farm forests is not more than one-third of the average for larger forests. Although these forests were not included in the survey proper, the German foresters did make rough estimates of their extent in each zone. Thus it was possible to make a comparison between the total forest area of Germany in 1946 and prewar estimates for 1937.

As a result of territorial losses since the end of the war the area of Germany's forests has been reduced by nearly 25 percent. Table 1 shows the reductions which have taken place, by kinds of ownership.[1]

TABLE 1.—COMPARISON OF GERMAN FOREST AREAS 1937 AND 1946

Forest ownership	1937 area	1946 area	Reduction	
	1000 ha.	*1000 ha.*	*1000 ha.*	*percent*
State	4,253	3,656	597	14.0
Community	2,614	2,070	544	20.8
Private:				
Over 10 ha.	4,119	2,181	1,938	47.0
Under 10 ha.	1,689	1,678	11	0.6
TOTALS	12,675	9,585	3,090	24.4

The total area covered by the 1946 survey, excluding forests under 10 hectares, was 7,907,100 hectares, including nonforested areas such as roads, glades, etc., which lie within forest boundaries. The net forested area was 7,547,600 hectares.

The distribution by types is as follows:

	1000 ha.	*percent*
Conifers	4,865	64
Broadleaved species	2,217	30
Clear-cut areas	465	6

Before the war it was considered normal that 1 percent of the total forest area should be in a clear-cut condition at any given time. The substantial increase in this percentage in 1946 reflects excessively heavy fellings during and following the war.

Volumes of standing timber were grouped in four tree-diameter classes, as shown in Table 2.

Average volume per hectare for all coniferous forests is 128 festmeters and the average in broadleaved forests is 129 festmeters. Average volumes on those areas of forest which bear timber 25 cm. or more in diameter at breast height are 272 festmeters of conifers and 240 festmeters of broadleaved species.

It is noteworthy that 40 percent of the total volume is contained in trees of 25 cm. diameter or more, that is to say, in trees large enough to produce saw timber, but only 9 percent of the volume is in trees larger than 35 cm. in diameter.

Sixty percent of the total volume of conifers is spruce and fir, and 40 percent is classified as pine and larch, although there are very small areas of other species in the latter group. Of the broadleaved species, beech accounts for 73 percent, oak 22 percent, and all others 5 percent. The tabulation of growth rates in Table 3 brings out the interesting point that average annual growth in coniferous forests belonging to communities is somewhat higher than that in state forests.

Estimates of growth in private forests under 10 hectares, in the U. S. Zone of Occupation only, show 1.5 festmeters per hectare for conifers, 1.1 for broadleaved species and an average of 1.4 for all species. Total annual growth for all zones is estimated to be nearly 30 million volume festmeters, but annual fellings in the postwar years have exceeded 200 percent of that amount.

The synoptic tables shown here present combined figures for the four Zones of Occupation, but the Report also contains many detailed tables relating to the U. S. Zone.

The Report gives the impression that in 1946 the forests of Germany were in good condition even though fellings had been at the rate of 150 percent of annual growth, or even higher, during the preceding 10 years. Average volumes of timber per hectare and growth rates per hectare are still relatively high. On the other hand, reforestation and thinning programs have fallen behind and a great deal of work must be done to bring the forests back to their prewar state.

[1]The table numbers here have no relation to table numbers in the original report.

TABLE 2.—VOLUMES OF STANDING TIMBER
Millions of volume festmeters with bark

Tree-diameter group	Conifers		Broadleaved species		All species	
	Volume	*Percent*	*Volume*	*Percent*	*Volume*	*Percent*
0-15 cm.	161	26	44	15	205	23
16-25 cm.	245	39	87	31	332	37
26-35 cm.	174	28	112	40	286	31
Over 35 cm.	45	7	42	14	87	9
TOTALS	625	100	285	100	910	100

TABLE 3.—AVERAGE ANNUAL GROWTH RATES IN FORESTS OVER 10 HECTARES
Volume festmeters per hectare

Forest	Conifers	Broadleaved	All species
State forests	4.6	3.6	4.3
Community forests	5.3	3.6	4.6
Private forests (over 10 ha.)	4.1	2.9	3.8
ALL FORESTS	4.6	3.4	4.2

Logging. Nelson C. Brown. Pp. xix + 418, 179 illustrations, $5.00. John Wiley & Sons, New York, 1949.

This book, written for the student and possibly the operator, is a revision of two earlier books on principles and methods of logging in the United States and Canada. It deals with the general problem of suiting logging methods to local conditions of topography, climate, density of timber, volume and size of individual trees. It also points out that the selection and application of logging methods have been affected by changes in selective logging; in efficiency, wages, and availability of labor; in improved mechanical devices, especially tractors, power-driven saws, motor trucks, and the small sawmill; and in improved utilization of both logs and species.

It is organized in 6 parts and 24 chapters. Part 1, General Introduction, contains chapters on Forest Utilization—General Considerations, Forest Resources and Stumpage Valuation, Forest Labor and Housing, and Partial Cutting (Selective Logging); Part II, Preparation of Logs for Transport—Felling and Bucking; Part III, Minor Log Transportation—Log Transportation, Animal Skidding, Tractor Logging, Power Logging—Cable-Hauling Systems, Combined Minor and Major Transportation; Part IV, Loading for Transport—Landings, Loading. Part V.—Major Land Transportation—Chutes, Wheeled Vehicles—Animal and Tractor Draft, Sleds, Motor Trucks, Forest Railroads. Part VI.—Major Water Transportation—General Considerations, Floating and Driving, River and Lake Rafts and Booms, Ocean Rafts, Flumes, Barges and Steamers, and Summary of Regional Logging Methods.

In most cases a description of the method is given, often with illustrations, the advantages and disadvantages are listed, characters of construction and operation are described, and conditions to which it is adapted are set forth. The book ends with a summary of regional logging methods.

Perhaps no single book of this size can give all the detail that a student of each particular method might wish. Significant omissions and some errors may be found by experts, despite the obvious care with which the book was prepared. But the book affords a basis for comparing adaptability of methods to different sets of conditions.

Bryant's *Logging*, last revised in 1923, is no longer fully up-to-date and no plan for further revision has been announced since the author's death. Thus the present volume stands alone in providing a reasonably comprehensive analytical up-to-date compilation on North American logging. It may prove of value as well in analyzing logging problems in unexploited forests, where modification of traditional hand-labor methods is under consideration. To the student it will be a valuable reference work.

THE Nations accepting this Constitution, being determined to promote the common welfare by furthering separate and collective action on their part for the purposes of

raising levels of nutrition and standards of living of the peoples under their respective jurisdictions,

securing improvements in the efficiency of the production and distribution of all food and agricultural products,

bettering the condition of rural populations,

and thus contributing toward an expanding world economy,

hereby establish the Food and Agriculture Organization of the United Nations . . . through which the Members will report to one another on the measures taken and the progress achieved in the fields of action set forth above.

—Preamble to the Constitution of the Food and Agriculture Organization of the United Nations

FAO Member Nations

Australia
Austria
Belgium
Bolivia
Brazil
Burma
Canada
Ceylon
Chile
China
Colombia
Costa Rica
Cuba
Czechoslovakia
Denmark
Dominican Republic
Ecuador
Egypt
Ethiopia
El Salvador
Finland
France
Greece
Guatemala
Haiti
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